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To Mould a Screw Propeller in Loam.

BY S. BOLLAND.

The moulder who has never seen a propeller wheel made has, no doubt, often asked himself the question, How is it done?

In explaining the method which I believe to be the best, I shall confine myself as strictly as possible to the moulder's share of the work, for it must be understood that the pattern-maker comes in for the lion's share of the credit in making wheels, and any moulder who should be called on to try his 'prentice hand on this job will do well to remember this, and keep on comfortable terms with him.

I have chosen a three-blade wheel, 10′ diameter, to make, as it enables me to give a better perspective view of the work as it progresses. Let the foundation plate *A*, Fig. 66, be 12′ diameter, resting on firm ground, and begin by striking the bearings *B* and *C*, Fig. 66.

The sweep for striking these bearings will bring the bottom of the hub high enough to allow the blades to be built. As the hub in this case is about 24″ diameter, a wood pattern is out of the question. Two ways are open to the moulder to form the hub; one is to work a sweep against the spindle as the blades are being built; the other to build a dummy pattern on bearing *C*, before commencing the blades. Such a one is shown at *D*, Fig. 66. Now, let a line be drawn all round the outside, as seen at *E*, and divided according to number of blades, which in this case is three. The inclined frame *F* is now set to line *E*, with center line *G* at line *H* on bearing *B*.

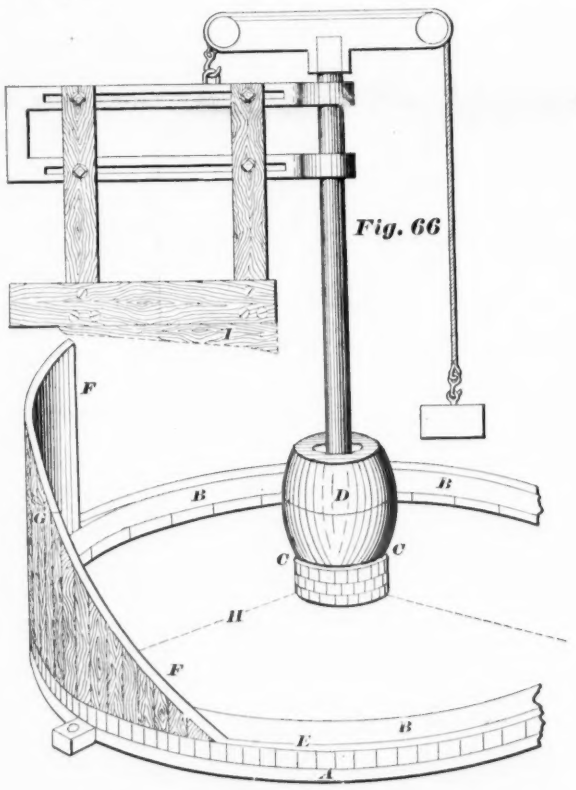


Fig. 66

With the view of helping the beginner in this job, I would here call his attention to Fig. 67, which is a perspective view of the blades as they will appear when built. By so doing he will better understand the various instructions he is called upon to follow.

As the sweep must travel on inclined frame *F* to give the required pitch of blade, the arms must work free on the spindles, rising and falling on the frame as needed. To accomplish this, a method is shown at Fig. 66, which is simply a cross beam, with socket to fit the top of the spindle, with pulleys at the ends, over which a rope travels, to the ends of which the board or sweep and counterweight are attached. The sweep is plain, and must be set in line with center of spindle.

The first process is to brick high enough for thickness of blade; to do this a guide piece *I* is screwed on the bottom of sweep, this being a true section of the blade from hub to outside. When all the piers are built to this, remove the piece *I* and build the rest, care being taken to keep the bricks on the outside of blade, and filling the inside with loam bricks made for the purpose, firmly set in soft loam.

You now sweep all the blades true to inclined frame, and as soon as hard enough the form of the blade must be marked off and cut out. Before moving the inclined frame *F*, mark the center line *G* on joint.

You can now bring the sweep board down to the line, and mark across from center to outside. This is the center of blade. Fig. 67 is a perspective view of your mould at this stage, with the three blades built. The lines *A* and *B* correspond to line on inclined frame at *G*, Fig. 66. The lines 1, 2, 3, 4, 5, 6, 7, Fig. 67, are scribed down with the sweep, and are an equal division of section of blade, as shown at Fig. 69. From the center line *A*, Fig. 67, is marked off on either side the width of blade, these being connected as seen at Fig. 67, gives the form desired. Fig. 69 shows thickness of blade at the several divisions, with lengths as well. To these sections guides must be made from which to work in cutting out the blade, taking care to have the surface true and even. You must now fill in with green sand, good and hard, giving another coat of skinning loam over all to insure an even and true face.

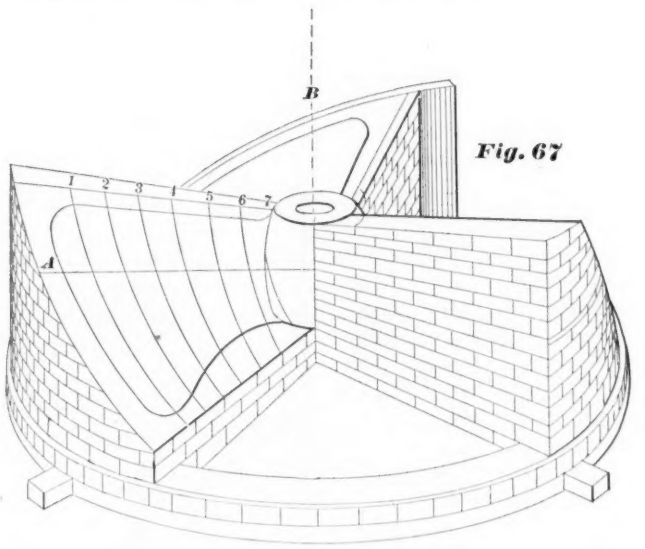


Fig. 67

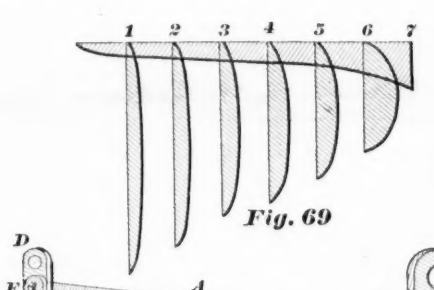


Fig. 69

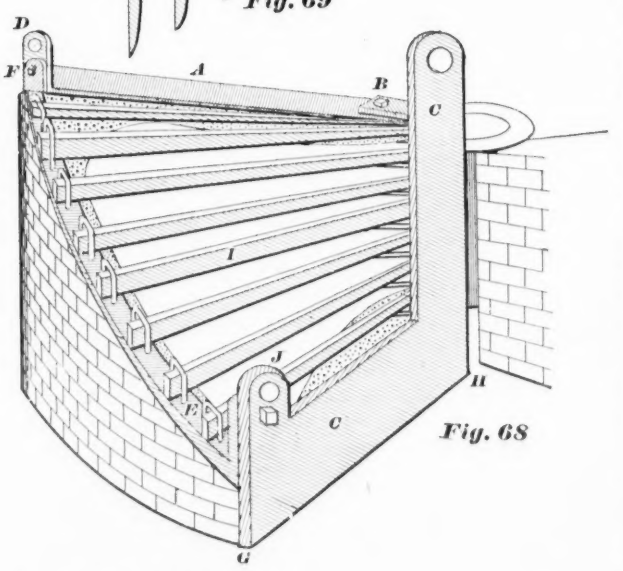


Fig. 68

MOULDING A SCREW PROPELLER IN LOAM.

At Fig. 68 is shown a way to construct the cope. *A* is a plate 7″ wide, 1½″ thick, with hole *B* cast to secure to plate *C* at *B*, a lug being cast at the other end at *D*, with hole to secure to plate *E* at *F*. Plate *C*, as will be seen, stands on bearings at *G* and *H*, and has bars cast on projecting towards the face of blade, on which to rest and secure other bars, which reach from plate *E* to center. This plate stands perpendicular, and the bars must be cast on it to suit the forms of blade, and also to clear the hub, taking care that the top lug comes correct at *B*. Plate *E*, as will be seen, has staples cast in through which the bars are put to carry the face of mould.

When the frame is firmly bolted together—on the joint, so as to secure the proper fit—it must be lifted away and clay-washed. Clean the mould and oil and parting sand the face; spread on the loam, and bed down the iron. The bars must now be put in and wedged in the staples, securing the ends at the hub with clamps or wire, as is most convenient.

All that remains to be done now is to fill in the spaces between the bars with bricks on end, packing them in tight with loam, and being careful not to press the ends of the bricks into the face of mould.

If the iron *C* is carefully made to fit the hub, there is little to do but fill up the spaces with brick and loam; but, as is often the case, the same iron must be used for a wheel of another pitch. Then irons must be used to bind the face of mould to the frame. The copes, being all marked as soon as they are set enough, can be lifted away. Set them down at *G* and *H*, and tilt back far enough to finish.

About 3″ or 4″ of bearing must be made all around top of hub, on which covering plate will rest, and provision for running and feeding must be made in this plate, the risers being taken off at the highest point of each blade. It will depend on the facilities you may have for drying and lifting your mould how you will now proceed. Should your oven be too small for the large plate, you can place a sheet-iron curb around and build fires between the piers, covering the whole with plates. Another plan is to strike a bearing outside and around the seating at the hub, on which to rest separate plates to carry each blade. By this means both top and bottom of blades can be dried in the oven and set back to stakes or marks, after they are dry. In very large wheels this must be done. In closing your mould, care must be taken to keep the foundation true to the position it was built, as if there should be any warping the wheel would be untrue.

The cross and slings can be used to bind down with, taking care to carry a packing from bottom lug of plate *C* at *J*. Plates may be bedded over the blades and wedged under the cross. Care must be taken whilst ramming over the blades.

Propeller wheels are made face down, in which case the first bed is finished off to the plain sweep at once. The position and form

of blade are obtained in the same way. The sections 1, 2, 3, 4, 5, 6, 7 are made about 1" thick and placed on the bed, sand being packed between and shaped off by hand to the form of back of blade, and the cope built as previously directed. This plan gives a little more trouble, but it insures a perfect face on the blade, as it takes its shape from the sweep direct, without any fear of alteration from rubbing or finishing.

The instructions here given to mould a screw propeller have reference to what is called a true screw. There are other kinds of screws made, some with what is called radially expanding, and others with axially expanding pitch. But as the question of pitch does not concern the moulder as much as it does the draftsman and patternmaker, I shall not intrude the subject here. At the same time I advise every moulder engaged on this class of work to inform himself thoroughly on this subject. By so doing, it will be much easier for him to follow the instructions of the designer or draftsman.

Making Gear Patterns.

By F. W. Barrows.

THIRD PAPER.

If you have no flat surface large enough to lay your wheel on, you may square across by the method shown in Fig. 26. Let the figure represent a portion of the circumference of wheel *c*, the point you wish to square from. With a gauge mark the line *a b* as near one side as you think will support your dividers. Taking *c* for a center, strike two points *a* and *b* with the same radius. Using these points *a* and *b* for centers, strike the arcs seen at *d*. Now a line drawn through the point *c* and the intersection of the arcs at *d* will be square with line *a b*. This method is equally good for bevel wheels, but for these it is better to use the instrument described by me in American Machinist for Feb. 20th, '86.

For the draft $\frac{1}{64}$" is sufficient for 6" face; this makes the tooth $\frac{1}{32}$" smaller on the bottom and the space that much larger. The clearance is governed by the pitch and the place the wheel is to occupy. A very good rule for the clearance is to take $\frac{7}{15}$ of the pitch for the tooth and the remaining $\frac{8}{15}$ for the space, making the tooth of the draft smaller.

Draw lines across the top of teeth at every tenth or twelfth tooth, and test them to see if they are square.

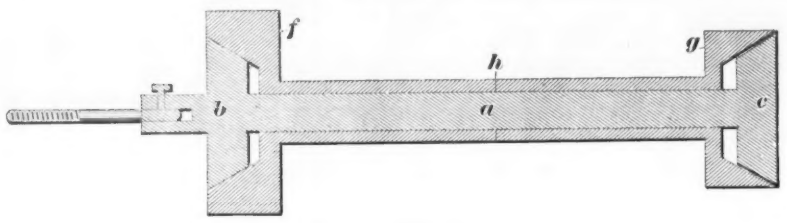
Space around with the same dividers you used for the first side, as the pitch circle should be of the same diameter on both sides of the wheel. It is a pretty good test of your skill in spacing to make the spacing come out right without any alteration of the divider.

Now you want a stiff pair of dividers to lay out the teeth after locating both sides of the tooth on the pitch line. In marking the outline of tooth turn your dividers in the same direction for every tooth, and don't bear on too hard. If you have first made a good surface with shellac, you will be able to see a pretty fine line. If you work with sharp tools, you don't actually need a line any wider than the edge of your tools. This would not be visible, so we will make it just wide enough to be visible.

If you take off the teeth to work them you will very likely be able to plane them out. Don't try to make the fillet at root too thin on the side next the rim if the teeth are not glued on. Unless you make the fillet like Fig. 27, instead of trying to make the full quarter of a circle you had better leave it off altogether, for you will make a bad job with too much feather edge when you strike a tooth that is a little cross grained. Some makers never put in any fillet, but I think that it not only strengthens the tooth, but also makes it easier for the moulder. It is very hard to prevent a sharp corner of sand from wasting.

The fillet shown in Fig. 27 gives an exaggerated example of the kind. In practice I should make them much nearer to the quarter circle.

In working the teeth don't leave all of the line on one side and cut it all off on the other, for this is wrong, and makes the same trouble that uneven spacing causes.



Tapping Device.

As I have said so much about uneven spacing let us experiment a little and see how a pair of wheels which are spaced badly will work. Let us first locate the bad places and number them like this:

1. A thick tooth. This makes the space on each side, or it may be all on one side, small.

2. Three or four short spaces, where you crowded the dividers a little, to make the spacing come out right (?).

3. Two small teeth and a large space between.

These faults are in the pinion or driver. In the driver wheel we find one very thick tooth. (I have seen a case so bad that the spacing and working together had made a difference of $\frac{1}{16}$" in the thickness of teeth at pitch line.)

The two wheels are fitted up and ready to run. Turn them slowly around and notice how the mesh works together. (In this case it would be more appropriate to say "mash"). No. 1 is on the line of contact and is the only tooth that touches, and will be until it is worn off to the correct size. No. 2 starts in and crowds the driver wheel faster as each of the short spaces comes up to the work, but if you look sharp you will see that each succeeding tooth takes all of the load upon itself, pushing the opposite wheel away ahead of the preceding tooth. This will make the wear on this part of the wheel excessive, and wi l give the driver wheel an uneven motion. It will also tend to throw the whole error on the first correct tooth, and if that big tooth on the other wheel should strike one of these short spaces I presume something would break. You didn't notice that big tooth when it went by, because it went into the large space, No. 3. If you will figure how many revolutions it will take to bring it into contact with the short spaces, you can tell about how soon you will be obliged to put in a new wheel.

One way to help this uneven spacing is to give lots of clearance. This may be done in the pattern, or perhaps some kind-hearted machinist or millwright who sets up the job will spread the wheels so far apart that the only danger will be that they may slip out of gear.

Another way is to cut the teeth similar to the teeth of a cross-cut saw. It would be almost impossible to break a tooth of this form; but the bearings of the shaft would require a good deal of attention and grease, I think.

After you have worked off the teeth without spoiling a single tooth, and each and every one is cut right to the center of the line, you will be pretty apt to think that you have got a good job. So you have; but let us try them with a pair of calipers, or, better still, with a gauge. Cut a piece of hard wood, $\frac{1}{2}$" thick, like Fig. 28. After making the distance from *a* to *b* equal to the depth of tooth below pitch line, saw from one side two thin pieces. These may be used as calipers by putting on a small handscrew. You can take two teeth and one space, or by turning the pieces both the same way you can take one tooth and one space. Don't be discouraged if the gauge shows a variation in the sizes of teeth and spaces, for this is the common failing and the greatest fault of cast gears. It may, and probably will, be only a slight variation.

Let the end *b* of the gauge go to the bottom of the space. Then if you find the teeth and spaces are all equal, you have got a good job. Be careful not to spoil it by sandpaper and varnish. Use a stick planed to fit the tooth for sandpapering, and put on the varnish very thin.

This wheel will make the moulder happy, and produce a good casting, if one good moulder does all the ramming.

If two or three moulders each ram up a part of the mould, you will probably find as many different sizes of teeth on the casting as there were moulders on the mould. This is nothing to the discredit of the moulders, who may all be good men, and still there will be a difference in their work. Any one of them would produce a better casting alone. But we will let the moulders make their own mould; we have done our part of the job.

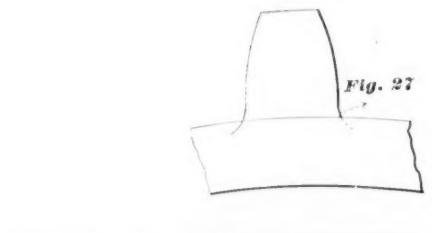


Fig. 27

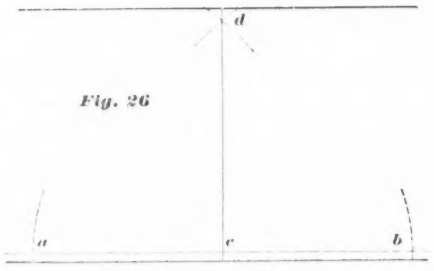


Fig. 26

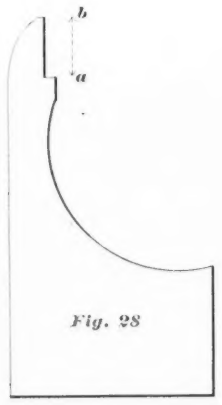


Fig. 28

In regard to the hub: I depend on the lower half to hold the arms together, and as the hub is generally deeper than the rim, if it is made fast to the spider, it will be in the way when you wish to lay the wheel on a follow board to mould. To remedy this, and at the same time support the arms in moulding, I cut the hub off even with the rim. The rest of the hub is loose with the coreprint. Make that part of the hub which is fast as small as you will ever want for a hub on this wheel. When you want a larger hub, fit it over this piece.

When making calculation for the clearance of teeth, you had better get the moulder's ideas on rapping patterns, for you may find it necessary to allow a little more clearance to enable him to get in his ideas on the subject.

In allowing draft on the teeth, remember that a mould will usually strain a little at the bottom. This, of course, will make the casting have less draft than the pattern.

Keeping Drawings.

A method of keeping drawings has been worked up by E. A. Mackintosh, draftsman, with P. Pryibil, New York city, who states that the principal points of the method were derived from the numerous articles published from time to time in the American Machinist.

All drawings are first worked up in pencil upon stout manilla paper, 19" × 24". These "original" drawings are filed, and if, as is generally the case, changes are to be made in the machines, the alterations are first made upon this original pencil drawing.

When corrected to suit, a tracing is made, inked in, and blue prints made, from which all work is done. The original pencil drawing and a tracing are always kept in the drafting room, while the blue print goes into the shop, and is easily renewed when damaged or worn out.

A blue print is also filed in another building for security against fire.

Large wrapping paper envelopes are used to hold each set of drawings, which consists of original tracing and blue paint.

The thick pencil drawing is turned face down and scored in the middle of its length with a knife, in order that it may fold up smoothly.

By being folded the pencil marks are protected from wear of putting in and out of envelope.

Each machine or device is known by a symbol. This mark is placed upon the upper right-hand corner of each drawing, where it can be readily seen when plan is folded, by raising one corner of the paper.

All envelopes containing drawings are kept standing upon end on shelves, similar to ordinary books. Glass doors protect the shelves and contents from dust, and perpendicular partitions, about 8 inches apart, which prevent the drawings from falling when but few are upon a shelf.

All envelopes are arranged upon the shelves in alphabetical order, and an explanation of the method of indexing is posted in sight to enable anyone unacquainted with the method to readily understand it, and to find on file any drawing.

In a partitioned drawer are kept a set of cards, upon which is marked the name and symbol of each drawing, the places on shelf where kept, and other information necessary. These cards are arrayed by alphabets in a similar manner to that used by most libraries.

A separate part of the drawer is divided in a similar manner, and is marked shop. When a blue print is taken from the drawing room, the card is removed, a blank card of different color put in its place, and the card placed in a division of the compartment marked shop.

If any drawing is called for, the draftsman can tell at once where the drawing is, and if it gets mislaid in the shop, he need have no hesitation about telling the shop foreman to go back and hunt until he finds it.

Tapping Device.

When a large number of small holes are to be tapped considerable time is lost in reversing the lathe, or tapping machine in order to back the tap out. There is also danger of breaking the tap, especially when using a bottoming tap.

The device shown in the engraving was designed to obviate the above difficulties, and is in constant use by the Brady Manufacturing Company, Brooklyn, N. Y.

The tap is chucked in the spindle *a*, which carries at either end a cone *b* and *c*. The back cone *c* is removable for putting on the slums which carry the pulleys *f* and *g*, both being loose on the shaft *a* and meeting at *h*.

Belts are run on *f* and *g*, one being open, the other crossed.

The large pulley *f* drives the drill, while the small pulley *g* backs out the tap at increased speed.

When the operator presses a casting against the tap to enter it into the hole to be tapped, he presses cone *b* into the pulley *f*, thereby imparting motion to the tap. When the hole is tapped, a pull upon the work causes *c* and *g* to engage, and the tap is backed out.

Should the tap bottom or bind from other cause, the operator does not apply pressure enough to cause the tap to be twisted off.

The *National Labor Tribune* says: "Wipe out the wholesale larceny perpetrated by the stock waterers, and half the grievances afflicting the country will disappear."

Electricity for Practical Mechanics.

By GEO. H. BENJAMIN.

THIRD PAPER.

In my second paper I stated briefly how the field magnets of a dynamo-electric machine are constructed. Two types were shown—permanent and electro-magnets. I have now to describe the methods commonly employed to excite the field magnets, and which depend upon the class of work for which the machine is to be employed.

Machines may be designed to furnish an electric current constant in quantity (amperes) for arc lighting, etc., or of constant potential (volts) for incandescent lighting.

In the various methods employed, everything depends upon the condition that the speed at which the machine is driven shall be uniform. Variations in the speed of driving, even though slight, have their effects multiplied in the transmutting apparatus, being evidenced by the flickering of incandescent lamps and sputtering, hissing and violent fluctuations in arc lamps.

The machines employed for arc lighting, etc., may have their field magnets excited in two different ways.

First — Separately excited. — That is, the current traversing the coil of wire upon the field magnets is generated external to the machine itself, as by a separate dynamo-electric machine. A diagram of such an arrangement is shown in Fig. 1, the large *D* at the left indicating the independent dynamo from which the exciting current is derived.

Where the exciting current is constant—as also the resistance of the working circuit—the field of force will always have the same strength, and the electromotive force of the current generated be always the same. If the resistance of the working circuit be changed, the electromotive force of the current generated will rise or fall, depending upon whether the resistance be increased or decreased. This system, however, does not admit of a wide range of adjustment, without varying the current from the excitor. With variations in speed the current will be approximately as the square of the speed (lamp working main and external circuit are synonymous terms).

Machines of this type have also been employed for incandescent lighting, where a given number of lamps are always in circuit, and it is essential that when so used, that some arrangements be employed to keep the same number of lamps in circuit, for the reason given above, namely, that the electromotive force will vary as the resistance of the external circuit. This style of machine has also been employed for the transmission of electric energy over long distances, for use with small motors, etc. They are open to the objection, that two machines must be operated instead of one, the excitor and the generator, and as a consequence, there is a certain loss of energy in the increased motive power required. Where a single machine serves as the excitor of a number of separate machines, the reverse is true, there's a saving. Quite a number of the largest installations of Europe have been organized on this system, but it has not been generally adopted in this country.

Second — Self excited.—That is, the current, traversing the coils of the field magnets, is generated by the machine itself, by the rotation of the armature of the machine. This at first sight appears incomprehensible, and the question naturally is asked, how can an organized mass of iron and wire, by the mere revolution of the wire before the iron, suddenly convert the iron into powerful magnets, and set up along the wire currents of electricity of tremendous energy? Where does the initial influence come from? The fact is, that the iron of the magnets has a certain amount of residual magnetism, which has been communicated thereto by the manipulations in the process of manufacture, or is acquired by the magnetic influence of the earth. When the armature of the machine is set in motion, the intensity of this initial charge is gradually increased, upon the same principal that a constantly applied force will produce accellerated motion. Little by little, the magnetism is built up until the point of saturation is reached, as explained by me in a previous paper. This accumulative action will be more fully considered when I come to describe the theory of the armature. Two types of self-excited machines are commonly employed for arc lighting:

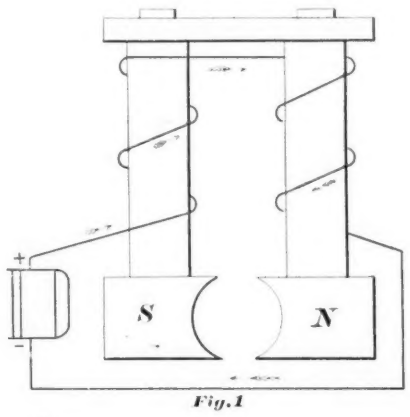


Fig. 1

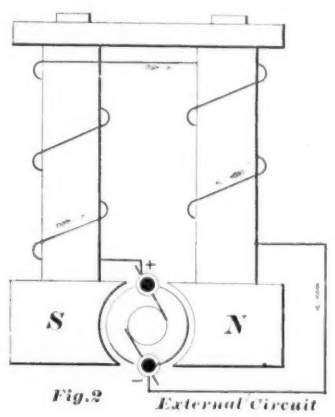


Fig. 2

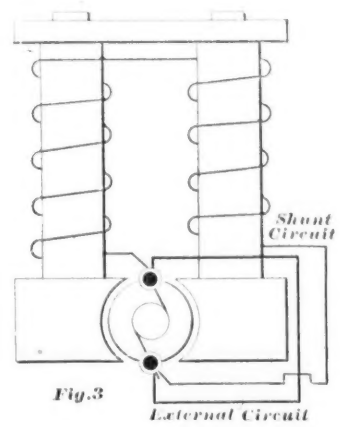


Fig. 3

(A) SERIES WOUND.

This is the simplest form. The coils upon the magnets are in the main circuit in series with the external work. That is to say, the wire which forms the coils of the field magnets is a part of the main circuit, and all the current generated by the machine passes through these coils.

Fig. 2 is a diagramatic representation of the method of winding the field magnet coils of a series wound machine. By means of this system of winding, the current generated by the machine will depend upon the resistance of the working circuit. To make this plain, we will suppose that a machine of 30 volts potential be working through a resistance of 3 ohms in the lamp circuit. Hence, by the the well-known law, $C = E \div R$, current equals the electromotive force (power to move current, volt) divided by the resistance (power to retard current, ohm), we have a resultant current of 10 amperes (ampere is the unit of current), 1 volt through 1 ohm equals 1 ampere. If we now double the resistance, the electromotive force remaining constant, owing to the speed of revolution being uniform, the current will be halved. Conversely, if we decrease the resistance one-half, the current will be doubled. In actual practice there is a considerable variation from these results, depending upon conditions which it is not necessary or proper for me to enter into. The rule, as stated, is sufficient for all practical needs. With changes in speed the current will be found to vary as about the third power of the speed, the resistance being constant. Machines of this type have been largely employed for arc lighting and various metallurgical operations. They are open to the objection that they are difficult to start against a large resistance, and are liable to have their polarity reversed when employed in charging storage batteries.

Various devices have been made for regulating the current from such machines in accordance with the exigencies of actual use, and which will be fully described in their proper place.

A word of caution as to the employment of series machines in charging storage batteries. The speed of rotation should not be lessened or the machine stopped while the accumulators are in the closed circuit; the circuit should be broken while the machine is at full speed, and no trouble will arise. Should the polarity of the machine be reversed, the simplest plan is to reverse the connections of the storage batteries to the machine, close the circuit, and allow the current flowing from the storage batteries to re-reverse the poles of the machine.

(B) SHUNT WOUND.

In this type of machine, which is that most commonly employed in this country, the current generated is divided unequally into two parts—or, more properly, caused to traverse two paths—of unequal resistance, one through the field magnet coils and the other through the lamp or working circuit.

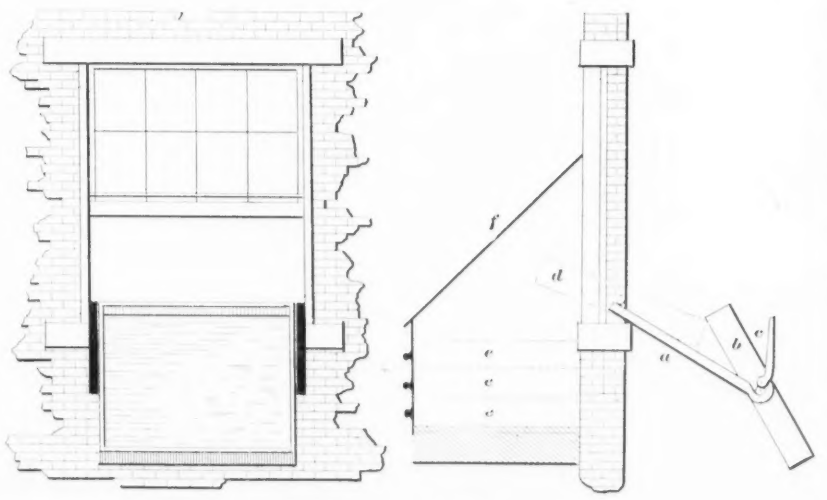
Fig. 3 is a diagram of such an arrangement.

It will be observed that the wire of the magnet coils is of much smaller diameter than that of the main circuit. By reason of this arrangement the strength of the magnetic field will depend upon the resistance of the working circuit, and hence the power of the machine to supply the required current will increase with the demands of the circuit, since any added resistance, as for instance, the introduction of one or more additional lamps, sends a slightly increased amount of current through the fine wire of the shunt coils around the field magnets, increasing the magnetism of the field and hence augmenting the electro-motive force generated.

To illustrate, we will suppose the resistance of the shunt to bear ratio to the working circuit as 10 is to 1, then if the E.M.F. be 30 volts, and the resistance of a single lamp in the circuit 3 ohms, the shunt will convey 1 ampere and the lamp circuit 9 amperes.

If we now double the resistance of the working circuit to 6 ohms, the first effect will be to send more current around the shunt, and so augment the strength of the magnetic field—the electro-motive force increasing to approximately 33 volts; double work is of course required of the motive power, and to bring the electro-motive force up to 60 volts to meet the new condition and to transmit the same current (60+6=10 amperes dividing as in the former instance) it is necessary to increase the speed of rotation of the armature or to change the position of the collecting brushes on the commutator relative to the points of maximum and minimum current, or both the speed and brushes will require to be changed. Various conditions serve to modify the above results, as for instance, induction of the magnet coils on each other, etc., the internal resistance of the armatures, etc.

Shunt wound machines have also been employed for incandescent lighting. This style of machine is very susceptible to inequalities of driving and requires intelligent handling.



BLUE-PRINTING PLANT.

Stereoscopic Views of Machinery.

The value of machine shop photography, although admitted, is not fully known to many mechanics. In showing up a machine, good photographs are decidedly superior to drawings, as everybody can readily understand a photograph, although they may not be able to comprehend a drawing.

In connection with rough models, photographs are invaluable, as they present the device with a clearness which is invaluable.

Stereoscopic views of a machine are of great value. With such views, the machine is so presented that it seems to stand out in bold relief, clear and distinct.

Duplicate views may be mounted for the stereoscope; they give the perspective and the magnifying advantage of the regular stereoscopic view, but do not give the view of roundness or solidity possessed by the view taken with two lenses.

Regular stereoscopic pictures are taken with two lenses, about 3½″ apart, virtually causing two sides of an object to be shown when the two pictures are combined with the stereoscope.

With two duplicate pictures, this absent point is to a great extent supplied by the imagination.

As before stated, the stereoscope can be made to do good service in showing up machinery, both for complete views and for details.

A Blue-Printing Plant.

A neat device for making blue prints is in use by E. A. Mackintosh, draftsman, with P. Prybil, New York city.

The ordinary printing frame is fitted with trunnions, similar to those used on the cope of a large foundry flask.

Two wrought iron guides are screwed to a window casing, and project out as seen at *a*, in the right hand part of engraving.

The ends of the guides are turned up to form hooks, as shown. The frame *b* slides on its trunnions, down the guides *a*, into the hooks, and may be firmly fastened then by the lever and cam *c*.

When the frame is put in the window, the back and springs are upward, and in position for examining the print.

After sliding into the hooks, the frame may be revolved upon the trunnions to the extent of an entire revolution if necessary. The left hand view shows the frame after it is turned glass side up, and at the proper angle to receive squarely the direct sunlight. At *d e e* is shown a set of drawers for holding fresh paper paints and printing frame. The top *f* is hinged at the upper side, and is made at an angle of 45 degrees to effectually prevent the piling of castings, patterns, or other machine shop truck, upon the device.

Notwithstanding the unfavorable showing of compound locomotives in England, we notice that they are by no means to be abandoned. We are pleased to note that this is so. There is reason to believe that with a better attention to details the compound engine may yet be a success. Some one must yet demonstrate this, either one way or the other. The sooner it is done the better.

Locomotive and Car Speed Indicator.

Numerous attempts have been made to produce a device that would show at a glance the speed of a locomotive or car, but certain impracticable features have prevented their coming into general use. A simple and cheap instrument for this purpose is shown in the engravings. As represented, the device proper is contained in case *A*, and connected with speed gauge *G* by pressure pipe *C*. This gauge is especially constructed to operate in connection with the device, and is graduated from 0 to 80 miles per hour. A reservoir is attached to back of speed gauge, which is filled with liquid of any kind, and connected to the device by pipe *B*. The reservoir being supplied with liquid, it will flow through pipe *B* to case *A*, filling it and rising through pipe *C* to gauge *G*, thus maintaining an equilibrium, and also supplying any loss of liquid from use, etc.

The internal mechanism of *A* consists of a worm closely fitting in a case, which has a connection at top with pipe *B*, and at the bottom with pipe *C*, leading to gauge *G*. The lower end of worm runs in close contact with a plate, which is perforated with diagonal holes, forming a chamber beneath the worm, in which revolves a conical disk. The liquid forced through the diagonal apertures strikes the conical disk, and is thrown off by centrifugal force, exerting a pressure on gauge *G* in proportion to the speed of the instrument. When the displacement of liquid ceases it offers a resistance to the exposed surface of the worm and conical disk, passing through it, and as the speed accelerates the friction on this surface increases in proportion, and is indicated upon the gauge *G*, thus showing the speed in miles per hour at a glance.

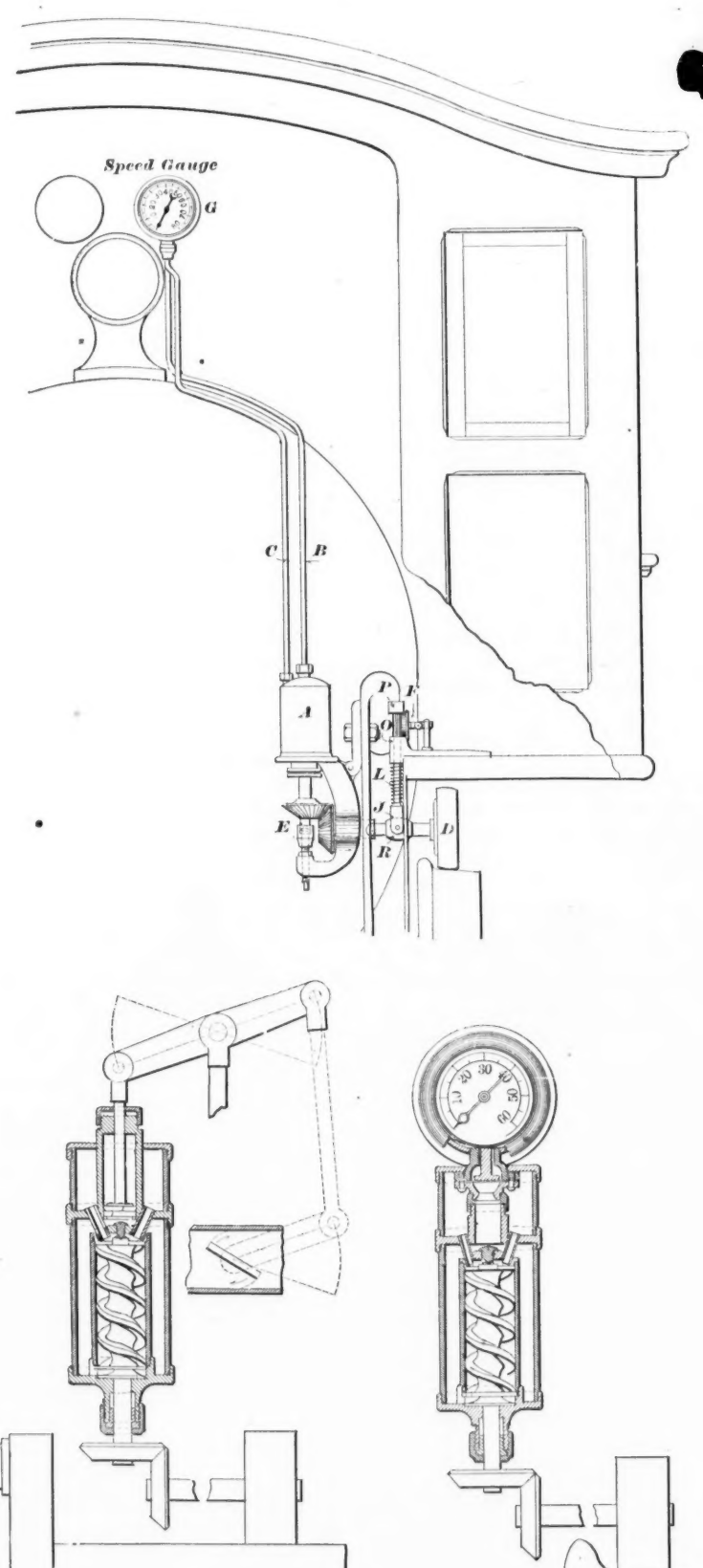
The instrument is so sensitive as to be affected, it is said, by a decrease or increase of speed of one-half mile per hour. The internal mechanism is operated by a perpendicular shaft having an internal bearing in *A*, and a center support at *E*, receiving its motion from the horizontal shaft by means of a miter pinion. Attached to outer end of shaft is the friction wheel *D*, which engages directly with the tread of the driving wheel, or any other wheel it may be desired to connect with. The pinion section of horizontal shaft has a stationary bearing, while the friction wheel section has a journal bearing *R*, swinging upon horizontal centers to provide for the vertical motion of *D* from spring of engine while running, and also to enable friction wheel *D* to be raised clear of driver when desired. The two sections of this horizontal shaft are coupled together by the ordinary ball universal joint. Attached to *R*, and standing perpendicularly from it, is a hanger *J*, having a support *O* bolted to the running board. Around *J*, and between *O* is a collar; upon bottom portion of *J* is a coiled spring *L*, which serves to keep wheel *D* in contact with driver wheel and to counteract the springing referred to. Upon upper end of *J*, is a second collar *P*, placed above, and by spring *L* held firmly against, an eccentric cam *F*, which is operated by a handle placed within easy access of the engineer. When the engineer desires to ascertain at what speed he is running he turns cam *F* so as to lower wheel *D*, and the instrument is set in motion at once, and as quickly tells how fast the engine is going.

All the bearings are made of anti-friction metal, and provided with easy means of lubrication. The perpendicular shaft has a gland and suitable packing at bottom of *A* to prevent leakage.

The indicator, as represented in cut is attached to the boiler brace in the cab, being driven from the main driving wheel of engine, but it can, with very slight alteration, be placed on the saddle of cylinder and operated from one of the truck wheels; the pressure pipes would then be carried under the jacket to the gauge in the cab.

Two styles of instruments are made, single and double-acting; double-acting to indicate speed when running backward or forward.

H. J. Small, assistant superintendent of machinery of the Northern Pacific Railroad, at Brainerd, Minn., and Mr. McNaughton, general foreman of the shops, are the inventors.



Locomotive and Car Speed Indicator.

Early Engineering Reminiscences.

By George Escol Sellers.

TWENTY-FIRST PAPER.

Having received a letter of enquiry as to my recollection of the invention of riveted hose and letter mail pouches, and the circumstances that led to these inventions, as it is a case in which inventive genius stepped in to fill a want when it occurred, I cannot do better than to reply to the inquiries through the columns of the American Machinist.

At the time of these inventions I was a boy of about nine years of age, but like most boys of that period of life, I took great delight in running after "the machine" on every alarm of fire, and not unfrequently, at fires, dropping into line to pass the leather fire buckets, of course on the return line of empty ones.

To the present generation, who have become accustomed to our city fire departments with their steam fire engines drawn by horse power to the fires, accompanied by thoroughly trained and organized men that scientifically attack and conquer conflagrations, it may be interesting to take a retrospective glance at the organization and the performance of private volunteer associations, supported by the public spirit and zeal of their members, with but trifling pecuniary assistance from the public crib. For it is to these organizations with their great emulation and rivalry, and to the intelligent and ingenious men belonging to them, that the invention and introduction of riveted leather hose is due. It is the most important improvement of the times in the mode of extinguishing fires. At the time I am writing of, Philadelphia had taken the lead of all other cities in America, and I might safely say of Europe, in improved fire apparatus. The old fashioned English Newsham side lever engines were still in use in New York. In Philadelphia they had given place to the more powerful end lever engines on which the men could more directly and effectively apply their force. The general plan of two single acting cylinders, with a center air vessel on the Newsham plan, had not been changed, except by increase in size, the end lever arrangements with their folding arms admitting of an increased number of men to man the engine.

This change in construction was mainly due to Patrick Lyon, a workman of extraordinary skill for the time. His full length portrait at his blacksmith forge, by Inman, now hangs in the Pennsylvania Academy of Fine Arts. The general plan of the long end lever, with the folding arms or handles, was originally suggested by Mr. Adam Eckfeldt, a sound, practical [illegible], and almost a life long cl[illegible] U. S. Mint. At t[illegible] tim[illegible] [illegible]ver one of the volunte[illegible] [illegible] —I think of the "Di[illegible]t of that I am not certain—[illegible] for that company that Lyon built [illegible] engine of that class. It was substantially the same type of engine as afterwards built by Merrick & Agner, until the time they were superseded by the steam fire engine. Pat Lyon had at his shop a little cubby-hole of an office, warmed by an old wood burning ten plate stove, around which he and his men would congregate of evenings to crack jokes, smoke their pipes and drink their grog. On a shelf in this office was a working model of folding levers with the long, wooden hand handles hinged to studs on crossbars between the side levers, that in an instant could be thrown open, grasped and firmly retained in clasps. They had additional out-riggers that on emergency could be attached, increasing the physical force by some twenty or twenty-four men. Pat never tired of working and exhibiting this model and expatiating on the great value of the arrangement, always attributing it to his friend Adam Eckfeldt.

The fire engine and hose companies were generally separate companies, but worked together. That is, hose companies, although professing to furnish water to the first engine on the ground, managed that their favorite one should be so considered. This often led to severe and sometimes bloody contests. Among these volunteer companies there were distinctive social grades. For instance, the Philadelphia engine and the Philadelphia hose companies, having their houses next to each other, were worthy of the Quaker element. They were rich companies, and indulged in the finest kind of apparatus regardless of cost. Their great oilcloth coats and capes, broad-brimmed japanned hats, were a peculiar and distinctive uniform. The Resolution Hose Company, a near neighbor, was mostly of the French element—sons, junior partners, and clerks of the large French importing firms. All their equipments were the pink of perfection. The Phœnix Hose was another of the aristocratic companies, and had many of the younger generation of Quakers in its organization. The Diligence, the Assistant and others of the city proper companies were composed of solid men of the city. The position of foreman of the companies was highly prized, as was also that of pipe men to the engine companies. Two of them on the gallery of the engine would direct the pipe to throw the stream of water onto the roof or through doors and windows of burning buildings—much of it to be dissipated in vapor without reaching the burning mass, and doing but little effectively towards extinguishing the fire. The companies in the Liberties, or outside of the city, as then incorporated, had not the wealth to lavish on fine apparatus and show but what they lacked in wealth they made up with vim and zeal rarely equalled and never excelled. This produced a rivalry that frequently led to rather serious results. Franklin Peale, at that time the manager of the Philadelphia Museum, that had its home in the old State House or Independence Hall, arranged a system of bell signals to indicate the direction of a fire from the State House—one stroke on the great bell, repeated at intervals, for north; two strokes, with regular intervals, for the south; and so on for the cardinal points and intermediates. On an alarm of fire being carried to the State House, the great bell would call out the entire fire organizations. Then came the great rush, the madding races, the ringing of the bells on the engine and hose carriages, the bellowing "Fire" through speaking trumpets that every fireman was armed with; it was pandemonium broken loose. The heavy fire engines or hose carriages, with their 1,000 or 1,200 feet of hose, were like a feather's weight to the string of men and boys who

manned their long drag ropes. It was the fouling of the engines or carriages in these furious races—contests for possession of the nearest fire-plug or hydrant—that led to the most disastrous conflicts, in which costly apparatus was damaged, hose spanners and speaking trumpets playing a conspicuous part, as many a scalp wound could testify.

Philip Garrett, a prominent watchmaker and jeweler, a member of the Society of Friends, was the foreman of the Philadelphia Fire Engine Company. He was in his element when fighting fires. I well remember that he was admitted by every one to be the *par excellence* of city firemen.

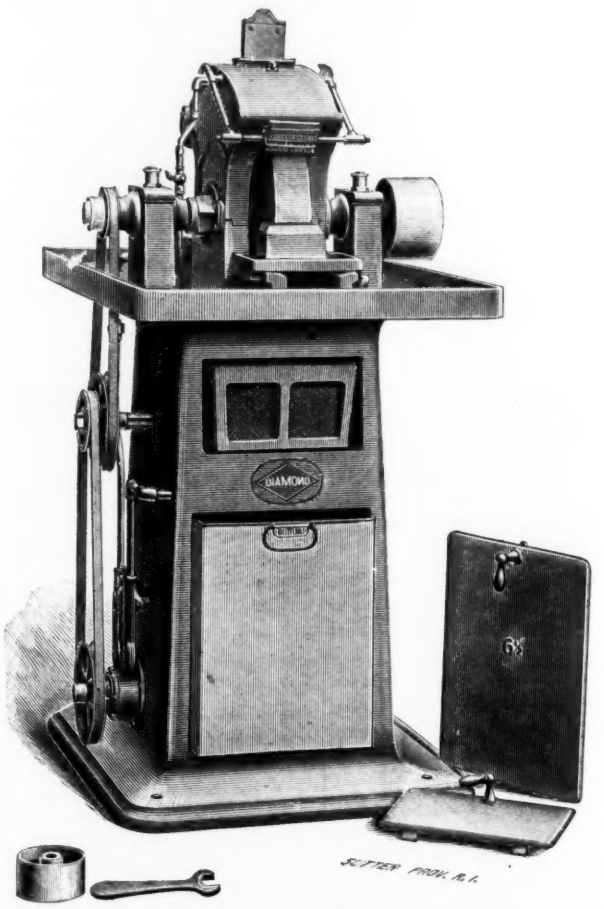
Often as a boy have I listened with great interest to conversations between him and my father as to the most effective mode of extinguishing fires. One point they were certainly agreed on; that was that by water the fuel or combustible matter and not the flame must be attacked. My father was never an active member of any fire company, though his name stood on the rolls of several as an honorary member. I think these were companies he had built engines for.

Simple as the question is, as it now appears to us, of applying the water through a hose directly to the burning fuel, it was at that time the great stumbling-block. Hose companies suffered so much from the ripping of seams, or bursting of hose as it was called, when subjected to the force and pressure of the fire engine pumps that they refused to allow it to be used in that way, This led to the invention of what for many years was known as the "Hydraulion," a combination fire engine and hose carriage in one, and was designed by my father, the Philadelphia Hose company being the first to adopt it, and the "Phœnix" the next to follow. A large number of a smaller class of these were built for country towns and smaller cities, Richmond, Va., Washington, D. C., and Providence, R. I., taking the largest class. The water supply of Philadelphia, in case of fires, was very deficient, the main supply being from the small reservoir in the dome of the pump-house in Centre Square (the present site of the new public buildings of Philadelphia). It was conducted through bored wooden logs of such small capacity that in case of fire citizens having hydrants were requested not to use them. Every block where the system extended was provided with a fire plug or hydrant, so poorly constructed that notwithstanding straw wrapping and wooden curbs they were apt to be frozen, and useless in cold spells; besides these fire plugs each square had a small wooden cistern sunk under the pavement, with a wooden hand pump for public use. These cisterns were kept full by a hollow copper floating ball, that opened or closed a common stop cock. Many of the old public wells had not been closed; their pumps were always of service. The hook and ladder companies ran with them a fire-bucket carriage; some of the engine companies also had their bucket carriage. All public buildings and halls, as well as many entries of private residences, had their suspended rows of fire buckets. These were made of leather, stitched as hose was, stiffened by "jacking," or saturated with a mixture of resin and wax over a charcoal fire. They were fancifully painted with the names of the institutions or parties they belonged to, and they played an active part in supplying water to the fire engines. It was not an uncommon occurence to see lines of bucket-passers of men and boys, and often women, slinging from hand to hand buckets of water from pumps as much as two blocks from the fire engine.

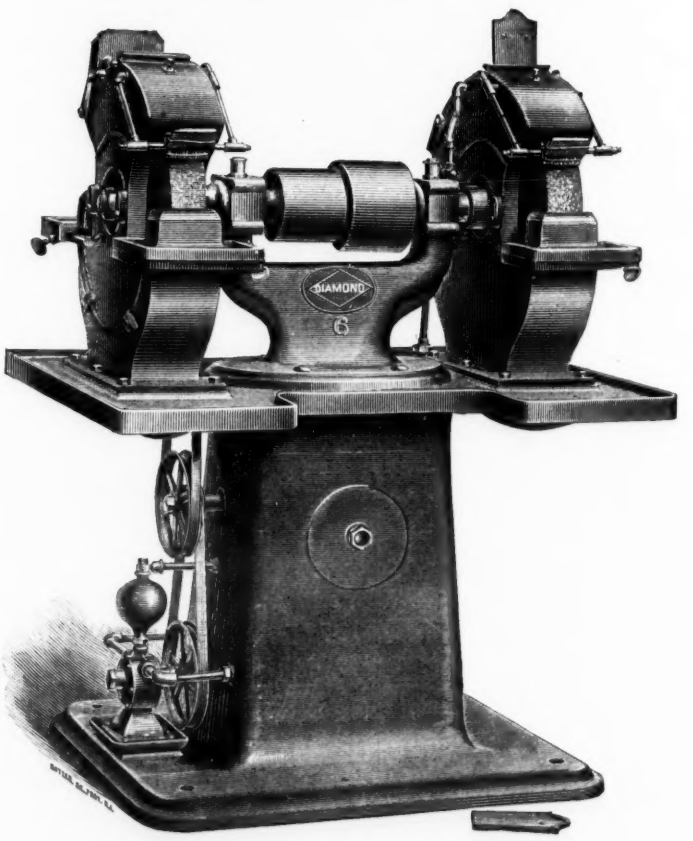
To understand the difficulties attending the use of sewed leather hose under heavy pressure, we must look at the manner of its construction. There were two plans. One was simply lapping one edge of the leather over the other, as is now done in the case of riveted hose, and sewing two lines of stitches from inside to out. The objection to this was serious. In dragging the hose when in use over the cobble stones of the street the outside stitches would soon wear off and the hose would rip. The plan generally adopted by the Philadelphia hose companies was to double or fold the leather so it would lay flat together, insert a strip of soft leather between, like a shoe welt, trim the edges straight, sew two rows of stitches through the leather and welt strip, exactly as harness traces are sewed. When the hose was opened this would present a ridge or rib from end to end, with the stitches protected from wear when dragging. The strain of head pressure was brought lengthways of the stitches as they passed through the leather. The soft leather strip was left to project slightly inside the hose, which, when wet and opened, was beat into the seam, tending to make it tight.

New hose when first made would stand the required pressure, but the hemp stitches would soon lose their strength. The dubbing of train or neatsfoot oil and tallow, which used to render the leather impervious to water and keep it soft and pliable, had the effect of destroying by a kind of rot the hemp stitching, so that its lifetime was very short. The stitches would give way while the leather remained in good condition. A stronger union than hemp stitches was not only desirable but was an imperative necessity, and more minds than one were working at it. About this time there occurred a great fire in the heart of the city that spread with fearful rapidity and mastered all efforts of the firemen.

I was standing with my father on the curb looking at the fire, when Philip Garrett rushed up in a great state of excitement, seized my father by his arm, and said: "Coleman, if thee can dam the stairways and hatchways of the upper floors of those two warehouses (pointing), and I can get a foot of water on the floors, we can stop the fire at that fire wall, but if we let it work down the walls will fall, and the whole block will go, and there is no knowing how much more." My father turned me over to some one to see me safe home, and left with Mr. Garrett. I learned afterward that my father, with board partitions that he tore down, succeeded with them and gunny bags in damming both stair and hatchways, making small crevices tight by having large quantities of bran thrown on the floors. The roofs were on fire and would soon fall in. Lines were formed for carrying up water by the bucketfull. Instead of going home as directed, I for hours had my place in the empty bucket line. While this was going on Garrett was having section after section of hose attached to both the Philadelphia and the Diligence Engines, only to burst before the water reached the upper floors. Fortunately the Resolution Company had a number of new sections of hose which were pressed into the service, and were attached next the engines where the pressure would be greatest. The floors were flooded, the attics and roofs fell into the water, and spreading fire was stayed. The success of this expedient was so complete that it turned the attention of all firemen in the direction of securing more reliable hose. The manner this success was brought about will be the subject of my next paper.



SINGLE WHEEL TOOL GRINDER.



DOUBLE WHEEL TOOL GRINDER.

Tool Grinding Machines.

One machine shown is to run a single wheel, 18″x3″, $1\frac{3}{4}$″ hole. It has bearing for spindle 7″ long $1\frac{1}{2}$″ diameter in the boxes, which latter are made as in an engine lathe and protected at each end by a dust-excluding device. Two pullies are supplied to the spindle, six and seven inches diameter, four inches wide respectively; this is used in preference to a cone pulley for the purpose of always having the pull of the belt close to the bearings.

The hood covering the emery wheel is open both front and back, the water being distributed on the wheel either directly in front of the tool when being ground on the wheel, or back of the gate, as the operator desires, the former giving more water directly to the tool than when distributed back of the gate or on the center of the wheel.

The hood inside has a raised surface cast which is the outside diameter of the flanges used and which leads all spray or water from the inside of the hood to the column, keeping it entirely from the spindle or boxes.

The rests are movable to and from the wheel without the use of wrench; collars, spindle (of steel), pulleys and all running parts are turned inside and out to obtain a well balanced, smooth running machine. The water distributed on the wheel flows over it and down through one channel into a sieve where all sediment, dirt, and foreign substance is held, leaving the basin below free from anything but water. This device frees the pump from much of the emery and grit which has before passed through it with the result of wearing and rendering it useless. Both the sieve and water tank may be removed conveniently and cleaned when desired.

No water will pass outside the pan or from the wheel in any manner beyond the table The latter has a pitch of about ten degrees, which does not allow the water to stand on the machine. The pump is compact. The suction pipe drawing the water from the tank has a filterer attached to prevent any substance but water passing through. The pump doors are shown to encase the opening. These openings for the water tank and filterer in the column can be put in on either side, except the one to which the pump is attached.

The weight of this machine is 750 pounds. It is furnished with "Hadley's" counter shaft and belt shifter.

The machine shown to run two wheels, 16″ × 3″ × $1\frac{1}{4}$″ hole, stands 40 inches high from base to center of spindle. The wheels are 24 inches apart. The hood in which the wheels revolve has an opening at the side, thereby enabling the operator to put on the wheels without taking the spindle from the boxes, or in any manner interfering with the bearings. The pump used is on the same principle as on the single-wheel grinder, but heavier and stronger. Of the emery wheels used, one is designed to be coarse for rapid cutting; the other finer, for finishing work or bringing tools to a finer edge. The machine weighs 1,000 lbs., runs a $4\frac{1}{2}$″ belt, and has "Hadley's" countershaft and belt shifter supplied. These machines are furnished with a novel and improved device for holding a diamond for the purpose of truing the wheel. The improvements on these machines are such as have been suggested in the use of other machines designed for this purpose. The manufacturers are the Diamond Emery Wheel and Machine Company, Providence, R. I.

LETTERS FROM PRACTICAL MEN.

Boring a Deep Hole.

Editor American Machinist:

I lately witnessed the boring of a $1\frac{1}{16}''$ hole in a steel shaft to the depth of 6 feet 8 inches. The boring tool was a common $1\frac{1}{16}''$ twist drill welded to a 1 inch bar of cold rolled steel making about 8 feet in length. A babbitted box was put on the tool post stand in place of the tool post, and the long, straight shank drill was grasped by this box just tight enough to keep the drill from turning with the cut, and yet in case of clogging it would turn in the box instead of breaking the drill. On each side of the box was a clamp-slip collar, the feed being by the regular carriage movement. The tail stock was run out of the way, as there was no use for it. The cutting was all done dry, and the drill was backed out, bringing the dry chips with it as often as the flutes were filled. The accomplishment of the work was in every way highly satisfactory. Old Jour.

Hot-Air Furnaces Advocated.

Editor American Machinist:

Having noticed a number of articles in your paper regarding the relative merits of steam and hot-air heating, I beg to say a word in favor of hot-air furnaces.

I have had some thirty-five years' actual experience in heating and ventilating all kinds of buildings, both public and private, and have always used hot-air furnaces in preference to steam. My profession has led me to closely compare the two, and I have no difficulty in convincing others of the correctness of my views on this subject.

I should state at the outset that, in referring to the superiority of furnaces, I mean only first-class furnaces, such as are made here in New England and doubtless can be obtained in any market in the United States. It is to be regretted that furnaces of an inferior make and workmanship are largely sold, and are very justly condemned by those using them. This, however, ought not to prejudice an intelligent person from seeing the merits that are peculiar to so many first-class furnaces.

One of your correspondents from Illinois seems to have been especially unfortunate in his experience with cheap furnaces he has met with in his locality, and he makes the extraordinary statement that no furnace has ever been produced with a gas-tight fire-pot.

The writer of this statement could hardly have been familiar with some of the excellent gas-tight steel plate furnaces that are manufactured in this market. To my mind it is perfectly clear that the prejudice against furnaces is owing to two causes—first, the cheapness and inferiority of the furnaces used and, second, the unworkmanlike manner in which they are set up.

Any village tinman will undertake to set up a furnace and pipe a house, when the job really requires the services of an expert.

The inevitable failure which follows is not due so much to the apparatus as to the imperfect manner in which it was set up, and the hot air connections made. As a professional in this line I can assert with confidence that there are thousands of houses all over the country that are successfully heated by furnaces in all kinds of wind and weather, and that it is just as practicable to heat a properly constructed house in a windy day as in a calm day. This objection to furnace heating, therefore, seems to me to have no force.

The quality of heat delivered from a furnace is essentially the purest that can be produced. It consists of fresh air brought directly from outdoors, and spread over the clean and moderately heated surfaces of the furnace, thence issuing from registers in the rooms above. This air does not have its moisture dried out of it, or absorbed out of it; in fact, moisture is never burned out of air or absorbed by the furnace.

In the same temperature of air there will be the same amount of moisture, whether it is heated by furnace or steam. The aridity of air is due to increased capacity for taking up the moisture, and not to the fact that it has parted with any of it.

One of the most serious objections in the use of direct steam heating is that the rooms are seldom ventilated. The same air is heated over and over again, and the temptation to economise fuel at the expense of the purity of the atmosphere proves too great with many people. Where a system of indirect steam heating is used by stacks of pipe in the cellar or under the registers, the joints are multiplied and a serious leakage of steam induced, letting the offensive odor of the packing around the joints escape into the room.

The liability of the steam condensing in bends of the pipe, and freezing up if the fire is allowed to go out in the winter time, is another danger resulting often in the bursting of the pipes, etc.

In addition to this, who is there that reads this article who has not experienced the insufferable nuisance of hearing the snap and rumbling of the steam pipes, which is liable to happen at all hours of the day or night. Furnace heating can be graduated, a light fire can be built in the furnace, and just enough heat produced to answer the requirements. With a steam apparatus it is different. The fire has to be strong enough to generate steam, and steam in its full force fills the pipe, producing a maximum amount of heat, which is always the same whether it is mild or cold, and the occupants of the room have their choice between being alternately chilled and overheated.

As for the economy of steam over the furnace, I am surprised that it should be maintained by any person who has had practical experience.

I have in mind now two schoolhouses of about the same size, and subject to the same conditions. One of them has a steam heater, and the other is warmed by furnaces. The schoolhouse using the steam heater requires 125 tons of coal during the season. The other building is heated more satisfactorily with the furnaces, with a consumption of 50 tons. This is not an extreme case. I have taken out a large number of steam heaters that fail to heat properly, and put in furnaces in their place with improved results.

I know of several cases where the boiler pipes have burst or leaked, putting out the fire, to the great inconvenience of the occupants of the house. It is a fact that what is called a first-class steam job will cost fully three times as much as a first-class furnace job.

As to the question of durability and expense of repairs, some of the comments made by your correspondents are wide of the mark.

If they will take the trouble to come to New England, I will take them to a dozen furnace manufacturers that will give a guarantee of a longer period of durability on their furnace, and a less expense of repairs, than any manufacturer of steam-heating apparatus in the country will give on his heater. In fact, a first-class furnace will bear a stronger guarantee than a steam heater.

A very serious objection to steam heaters is that the majority of them are sold at a distance from the works where they are made, and if anything gives out, it requires the services of an experienced mechanic, who must be brought from a distance at a great expense. On the contrary, if a furnace gives out in any particular, it is something that can be repaired by the man himself with the aid of suggestions from the manufacturer by correspondence, or any tinman can attend to it for him at a very slight expense.

Steam heaters having complicated and delicate parts rust and are subject to chemical changes in the summer months much more than furnaces. When in operation during the winter months they cannot in an emergency be left to the care of the ladies of the house, as is sometimes necessary. They generally require the special management of a trained person, and cannot be trusted to novices. Furnaces, however, are much more manageable, and submit to occasional incompetent treatment without serious results.

I think no one will question the fact that the presence of the steam boiler in a house is a standing menace to the safety of its occupants. Steam boilers have one fatal defect; they can be blown up, and frequently are. The recent terrible explosion at Fort Wayne, Ind., in which the boilers blew up, instantly killing the janitor and one other person, and demolishing a $65,000 church, is doubtless fresh in the minds of all the readers of this article. That church is being rebuilt, and its specifications now call for heating by furnaces.

The hazardous nature of steam heating is being better realized every day, and it is not an exaggeration to say that every steam boiler now in use carries within itself the possibilities of a serious explosion.

I have taken the liberty to summarize at this length my objections to steam heating; as so much space has been taken up by those on the other side of the question, I feel I may be allowed space to thus fully state the opposite view. I speak from my own conviction and experience in the matter, and can furnish numerous examples as to the greater practicability and economy of furnace heating over steam in this market.

C. G. Rowell.

Boston, Mass.

Compound Engines.

Editor American Machinist:

In my late papers on the Compound Engine for Stationary or Factory Purposes, I did not mention the well-known benefits to be derived in compounding by the equalization of the strains on the main bearings, pins, etc. This is one of the most important items gained by the system; but time will not allow me at present to lay before your readers much practical data on this vital portion of the subject. Neither have I fully explained the many methods of triple and quadruple compounding now being successfully introduced in marine engineering. The number of expansions is only limited by the practical pressures that boilers will safely carry.

We have no material yet at hand that will safely stand over 200 lbs., and even then the shells for even moderate-sized vessels and medium powers must be from $1\frac{1}{8}''$ to $1\frac{3}{8}''$ thick, of steel. With the triple system, however, 165 lbs. of boiler pressure is enough as a maximum, 150 lbs. being a fair boiler pressure; and boilers from 10 to 13 feet for marine, and say $5\frac{1}{2}$ to 7 feet for stationary purposes, can be made of ample strength for these pressures. Of course, the marine boiler is fired internally, so the shell can be thick; but our stationary boiler is fired externally, and therefore cannot have a very thick shell, $\frac{5}{8}$ of an inch being, according to my experience, the limit for durability; and at this thickness the heat penetrates very slowly. Externally fired shells should not be over $\frac{9}{16}''$ thick, except in special cases.

W. H. Hoffman.

A Question About Air Brakes.

Editor American Machinist:

As a reader of your valuable paper for the past 5 years, I have gained much useful information, and for the first time, I would ask the privilege of placing before the readers of the American Machinist a question upon which I, as well as others, desire enlightenment.

Recently there was overhauled in the roundhouse of the A., T. & S. F. R. R. Co., at this station a 6″ standard Westinghouse air brake. This brake was well cleaned, new air valves, slide valve in central chamber, and some new rings put in, the others being opened and made to fit neatly in their respective places. The air-receiving valves were given $\frac{1}{16}''$ lift, and discharge valves $\frac{1}{32}''$. The pin on which the main valve strikes at the bottom was renewed, the old one being so much worn as to let bottom ring of main valve almost through the bushing. The new one was made long enough to allow lower piston of main valve to clear the steam port well, which was considered as far as there was any need of it traveling in that direction.

When this pump was put to work it developed but a single defect. The stroke was regular, indicating that the lift of air valves was equal; it would work with very little steam, and pump all the air necessary; it reversed for the down stroke so easily that it made no jar whatever, but when reversing for the up stroke it went with a thud, which would jar the whole engine. Aside from this the pump works very nicely.

Perhaps if you will kindly give this place in your columns it will attract the attention of those who from extended experience have become expert in these things, and familiar with their ailments, and who will be able readily to explain the cause of the trouble with this particular pump. It goes without saying, that any information tending to familiarize the mechanic with the air brake apparatus, and the remedying of its disorders, will be of no small benefit, considering the place it holds in the mechanical world as a braking medium. T. Paxton.

Railroad Notes.

The Brooklyn City Railroad extends from Twenty-fifth street to Fort Hamilton, a distance of about five miles.

At present 11 dummy engines are in use, together with 50 cars. Several short but severe grades on this road have made heavier engines necessary, and we are informed by Master Mechanic H. R. Hawley that six locomotives are in process of construction for this road by the Baldwin Locomotive Works.

The upright boiler is being discarded for the horizontal one, which gives increased steadiness to the locomotive, greater weight on and decreased wear of the rails.

A few hand tools enable engineers to make minor repairs at the engine-house. A small hand shaper is highly prized, and is kept in constant use.

A screw cutting lathe, driven by a man through a crank and heavy fly-wheel belted to a countershaft, looks like a good device for doing odd jobs with.

The Brooklyn, Bath and Coney Island Railroad, Aug. Wolff, master mechanic, is the pioneer road to Coney Island.

Eight Baldwin locomotives are used on this road, together with about 36 cars.

At present the road is being put in order for the summer traffic, which is very heavy. Six of the locomotives are being built over two at present being in the shop.

This company has recently changed hands, and the entire plant is to be overhauled and put in excellent condition.

In the shops of this road we noticed that which is lacking in many shops which care for a hundred or more locomotives, viz., a good heavy vise.

T-o vises of the heaviest in the market were here well mounted on stiff benches, and were well appreciated by the men.

A piston-rod could be clamped in this vise, and the follower bolts removed from the head, with the comfort of knowing that the work would not "squirm" during the operation.

The Prospect Park and Coney Island Railroad, eight miles long, uses 9 locomotives, 50 cars, and is in charge of Master Mechanic Martin Painter.

A locomotive with $13'' \times 18''$ cylinders, and 44 inch drivers, and a very good record was shown with pride by Mr. Painter. This locomotive was built at the Baldwin Works, to specifications by Mr. Painter, who was formerly with those works.

This engine, No. 9, has extended smoke-box, straight stack, and adjustable diaphragm in front of the tubes. Single exhaust nozzle, 4 inches in diameter, and placed just above the netting, which is on a level with the top row of tubes.

This diaphragm was first placed very near the bottom of the smoke-box, giving a contracted passage for the gases from tubes to smoke-box. During a series of experiments, the diaphragm was raised gradually until it was found that the increase of opening gave no better results, and that a further increase of opening led to a positive loss. The diaphragm was bolted fast at the point, which gave best results, and has there remained for two years.

The steam ports are $\frac{7}{8}'' \times 12''$, very small steam chest, and plain slide valve. This engine has drawn a train of 3 loaded cars, 100 passengers to each car, trips of $12\frac{1}{4}$ miles, making two stops, in 15 minutes, burning 216 pounds of coal per trip.

A system of "brass checks" is used in giving out coal to each engine. On one side of the check is stamped the number of engine, and on the opposite side, a number ranging from 4 to 8, 12, 16, and 20.

A number of these checks are given to each engineer and are kept by him.

All coal is put upon locomotives from measures called "kegs." Each "keg" holds 42 pounds. If four kegs of coal are given out, the engineer who receives the coal gives a check marked 4 to the coal keeper. If 16 "kegs" of coal are given out, a corresponding check is delivered.

These checks are turned into the office each day, and their value must correspond with a report furnished by the engineer to the master mechanic.

The Brooklyn, Flatbush and Coney Island Railroad is about 8 miles long; 8 locomotives and 40 cars are used upon the road, and are in charge of Master Mechanic William Finley, who also has the care of all locomotives used upon the Coney Island Elevated Railroad.

The 8 engines used upon the Flatbush road, which is in the hands of receivers, are all of the Cook pattern, heavy engines, 17 × 24 cylinder. At present two are in the shop being overhauled.

Considerable trouble is experienced by Mr. Finley in keeping up the fire sheets of the water legs. Where the corrugations occur the sheets invariably crack, require to be plugged, and necessitate patches and new sides.

The water used upon this road is bad, added much to the trouble by corroding wherever a slight leak occurs.

As fast as the corrugated sheets give out they are replaced by plain sheets, and no further trouble is experienced.

The Cincinnati, Hamilton and Dayton Railroad and leased lines, which are the Cincinnati, Hamilton and Indianapolis, the Cincinnati, Richmond and Chicago, and the Dayton and Michigan have their general shops at Lima, O. At present business is only fair. General Master Mechanic Mr. John Black, has just turned out a new six-wheel pony engine, 16″ × 22″, with extension front and link motion, designed to stand service, as well as giving good distribution of steam. The cross-head, which is of the perpendicular type, is made in three parts—the center of wrought iron, the shoes of cast iron, running on cast-iron guides. Many years ago Mr. Black adopted ten threads per inch as a standard for all bolts used on locomotive work, from ⅝″ to 1½″, and when screwed up they remain "home."

For general repairs about five engines are always in. Mr. John Black, Jr., general foreman of the machine shop, gives his personal attention to every piece in detail that is to have any work done on it. Nothing but a first-class job is ever permitted to leave their shops. The side-rods used by this company are of the "fish" pattern, 5″ deep in the middle by 1¼″ thick. They are forged under the steam hammer of good iron, and are left 1½″ longer than they finish. After being centered they are faced up to required length, leaving a projection ¾″ long by ¾″ diameter at each end. These projections are used to plane the rods on, instead of between the centers. They are planed all over.

This company has experimented with two pairs of balanced valves of different patents, neither of which have yet proven satisfactory. The air-pump work is entrusted to one machinist who does the entire job, lathe work and all. The air-pumps are tested in the boiler room before going on the engines. In their repairs every piece is kept to the Westinghouse standard. In the car shops this company has just completed a lot of 50 "buggy cars." The general dimensions are: Length, 34′; width inside, 8′ 2″; height inside, 9′; and 14′ 2″ from rail to top. They are also building 15 "automatic unloading" gravel cars, besides doing the general repairs.

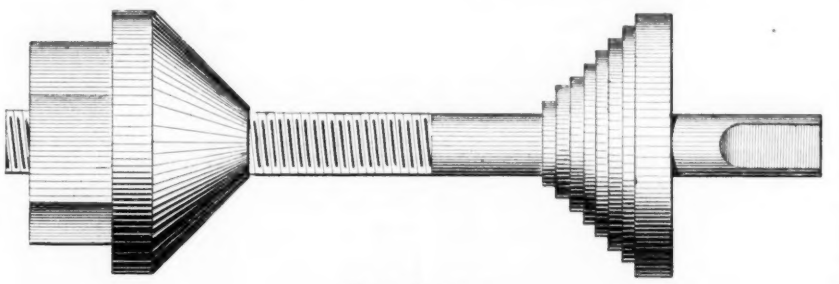
Gang Arbor.

The illustration represents an arbor for cutting gears, and may be used for blanks having a diameter of bore from 1 to 1⅞ inches.

Other arbors are used having a range according to needs of different jobs. They may be made to accomodate any desired range of sizes.

As made by their inventor, Adolph Shutte, foreman, 461 West Fortieth street, New York, two sizes are used, each graduated to ⅛″ steps, one tool being made to even sizes such as 1⅛″ and 1¼″, the other arbor being turned to 1 1/16″ 1 1/16″ and upwards.

The flat portion at the right, serves to receive a set screw, which holds the arbor in the gear cutting machine.



GANG ARBOR.

A number of blanks being put on the arbor, the first one is seated upon one of the steps. Then the cone is slipped into the last blank, and the nut slightly tightened.

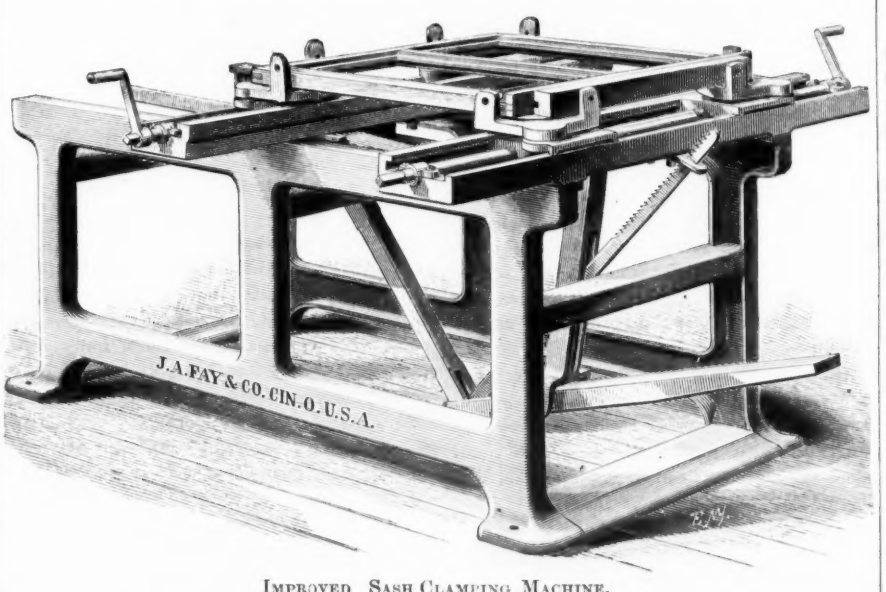
The whole is then put between centers and all the middle blanks trued up by the two end ones. The nut being tightened home, the arbor may be put into the gear cutter, and all blanks on it cut in the usual manner.

The device is not patented, and readers of the AMERICAN MACHINIST are at liberty to make and use it.

Improved Sash Clamping Machine.

This machine was designed to meet the wants of sash and door manufacturers for a substantial and convenient machine.

It is made with heavy plate sides and girts.



IMPROVED SASH CLAMPING MACHINE.

On the top are placed two heavy rails, in which are mounted the corner bars for holding the sash. These are pivoted to traveling plates, through which pass a right and left hand screw, by which each corner can be moved an exact distance from the center, and at the same time remain in a rigid fixed position.

When it is set square for one size, it always remains square, and will work all sizes, and is not easily disarranged. Odd sizes of sash can be clamped almost as quickly as regular sizes. It is quickly adjusted, and when ready a pressure of the foot upon the treadle is all that is necessary to instantly secure and clamp the sash. While the pressures upon the sides and corners are simultaneous, they can be made independent if desired. Its capacity is to work sash up to 3′ 10″ × 5′, and down to 12″ square. The manufacturers are J. A. Fay & Co., Cincinnati, Ohio.

Public or Private Water Works for Fire Purposes.

J. G. Briggs, superintendent of the Terre Haute Water Works Company, sends us a copy of an essay on "The Relative Economy of Water Supply Under Municipal and Private Control," which he wrote and had published several years ago. He takes strong ground for private ownership, and dwells especially on the fire protection feature of the question. Mr. Briggs says:

Water works, whether owned by municipal or private corporations, are expensive institutions to build and operate. In either case they should be conducted on the same general principle. In the first-named they pay for fire protection in the shape of interest on the cost of the works, and whatever the repairs, renewals, extensions and running expenses exceed the receipts from private consumers. In the latter the city pays the owners directly and has no further trouble or benefit in the concern.

Perhaps some evidence from the fire engineers themselves will throw light upon the question. In 1881 the National Association of Fire Engineers held their ninth annual convention at Richmond, Va. Following is part of the report which was adopted by that convention:

Your committee, to whom was assigned topic No. 10, "Should the water works of a city be owned and controlled by the city or by a private corporation?" would respectfully report that they find in cities where the water works are owned by a private corporation, as a rule, the rates for water to private consumers much higher than in cities where they are owned by the city. That the rates charged the cities by private corporations, as a rule, are exorbitant for the service rendered. The private corporations do not extend their mains through the suburban districts as rapidly as they are built up and the necessities of the fire department require.

In a number of cities we find this to be the case to so great an extent that the apparatus ordinarily responding to an alarm in many districts cannot carry sufficient hose to reach the fire from the nearest available water, and are compelled to either keep extra apparatus for those districts or rob the heart of the city of its protection, while it is in use in some cases miles away. And as the city authorities have no control over the water companies, they are powerless to remedy the defect, except by paying an exorbitant tax, or wait until the water company can obtain a sufficient number of paying customers in the district to make it a profitable investment.

A city or village, after a good, lively fire, concludes that a water supply for fire purposes is needed. A public meeting is called, estimates of the cost are submitted; the number of thousands of dollars that it will cost looks so formidable that the good people are scared and the project is abandoned. A number of capitalists quietly get together and conclude that it will pay them to furnish the town with water. The proposition is made to the authorities or at a public meeting, and it is received with acclamation. The company is accorded extraordinary privileges for its patriotism in relieving the town from a tax for years to pay the principal and interest on water bonds. The company lays its mains through the principal streets, and places hydrants in the heart of the town, where it will pay. The deluded taxpayer is charged a rate for water for his private use that pays the water company a handsome profit on its investment (in many cases greater than his tax for all purposes would have been had the town built the works) and besides, with his brother taxpayer, who resides in the outskirts of the town, who receives absolutely no benefit from the company, pays his share in the form of a city tax and in good round figures, too, for water used in public buildings and for fire purposes.

Mr. Briggs writes us a letter on the subject "not for publication," which reservation we regret, because we are always willing to give place to original arguments against any position we take in these columns. The AMERICAN MACHINIST is not afraid to publish any points that can be urged against anything it advocates. We take no position that cannot be sustained by reference to admitted facts or by fair open argument.

A Novel Vise.

To be able to adapt to one's needs whatever material may be at hand is one of the points which go to make up the "good mechanic." Such a man does things quickly and well, where the "poor workman" would give up as "stuck."

A case occurred on a railroad not long since which substantiates the above. A locomotive broke down out on the road. The engineer, whose name could not be learned, although he is worthy of being put on record, found he would be able to make repairs and proceed if he could have the use of a vise for a few minutes. After a few seconds' thought, the piece of iron to be held was put between driver and brake-shoe, and the fireman requested to put on the air.

No better vise could have been found, and that brainy engineer was soon on his way in.

A short time ago it was given out that paper rails had been made and successfully tested. Now, the same material has been utilized for making pipes, and a certain quantity of such pipes have been exhibited in Vienna. The process is as follows: Strips of paper, the width of which corresponds with the length of one pipe section, are drawn through melted asphalt, and wound upon a mandrel. When the pipe thus made has cooled, the mandrel is withdrawn, and the inside is covered with a kind of enamel, the nature of which comprises the main secret of the invention, and is therefore not made known. The outside is painted with asphalt varnish, and dusted over with sand. It is stated that such a pipe will resist some 2,000 lbs. internal pressure, though the thickness of the stuff is only about ½ inch.—*The Universal Engineer.*

According to our English exchanges, there are but little signs of business improvement in England. Orders for engine work are said to come forward slowly, and the steel companies are about through with their orders.

We have just had brought under our notice a new kind of core well adapted for foundry work. This is the carbon core invented and manufactured by Mr. R. Applegarth, of the Atlas Works, Ewer street, Southwark street, London, and which is gradually superseding sand cores in practice. The carbon cores are made of various diameters, and in 10-inch lengths, and are stated by users to make a perfectly smooth hole, and in many instances to save the trouble of boring. They are much stronger than sand cores, never crush or break in the mould, and can easily be punched out, and may often be used a second time. When these cores become known we think they will have a very good run with brass and iron founders.—*Iron.*

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NEW YORK, MAY 29, 1886.

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Unions to Prevent Labor Troubles.

The movement among workmen in several industrial centers for fewer hours of labor has caused considerable commotion, but the strikes and other temporary annoyances are likely to be over in a brief period. The more lasting effect is likely to be an advance in prices of many commodities, which, far from being an evil, will prove a public benefit. Declining prices always have a depressing effect upon business, while advancing prices stimulate and increase business, especially when most articles have been reduced so low that there is very little, if any, profit in their production. It could not be expected that manufacturers could change from 60 to 48 hours running time a week and pay the same wages. A few may try the experiment, but are not likely to continue it long. Competition will regulate all excessive inequalities in hours of labor and rates of wages in each of the trades.

The fact is apparent that a large part of the workmen of the country are anxious to have fewer hours of labor in shops, mills, factories, and various other industrial establishments. If employers generally could be assured of the universal adoption of a rule establishing a shorter working day or week at some definite date hereafter (giving sufficient time to provide for readjustment), the change could be made without labor disturbances. The impossibility of arriving at any such universal understanding at present arises from the fact that while workmen in almost all the industries are organized into unions so as to act together regarding labor, manufacturers have very few unions, formed upon a basis to regulate action upon labor matters. We do not claim to be able to point out any supreme remedy for labor disturbances, because there is no absolute remedy. We are firmly convinced, however, that when manufacturers are as fully organized into trade unions as workmen now are, productive industries will be conducted with much more safety and security, as labor troubles would be fewer and easier settled. In the iron manufacturing business of Pittsburgh and the West both manufacturers and workmen are thoroughly organized into unions, and while, during the past few weeks, most other trades have been disturbed by strikes and threats of strikes, not a ripple of labor trouble has been discoverable in the great iron and steel industries covered by the unions mentioned.

Since the strikes in Chicago have upset business so badly, an organization has been formed there, composed of 105 firms in the manufacture of metals and metal goods. They employ about 25,000 hands. Its object is "to promote the welfare of all its members by united action." They say in their constitution:

"We recognize the fact that workmen have rights and may have grievances, and it will be our duty to protect them in every way consistent with justice and honorable treatment, to the end that harmony and good will may prevail, believing that the best interest of employer and employe will be protected by such organization, and to this end recognize the right of petition."

We believe that manufacturers everywhere will recognize the desirability of forming such associations, so as to prevent future labor troubles.

What Skilled Labor Is.

It looks as if we should soon require a new definition, setting forth what skilled labor really is, or, more correctly, what is meant when the term is used. Writers use the term flippantly, and generally in a way to include or exclude pretty much everything, according to their peculiar ideas on the subject. It requires some skill to do work of any kind on the one hand, and on the other some kinds of work demand much more skill than others, hence the latitude taken.

The old-fashioned idea—and it is a good one because it means something—was that those who followed occupations more or less of a mechanical nature, requiring some years of preparatory work at nominal, or at least small, wages were skilled workmen. If this distinction were maintained we should have a fair idea of what was meant when we read of skilled workmen, or skilled labor. It does not necessarily include those only who serve an apprenticeship to a trade.

A locomotive engineer, for instance, goes through preparatory work as fireman, and in comparatively unimportant positions, of perhaps five or six years, or even more, before he acquires the necessary skill. He is in a high degree a skilled workman, although, popularly speaking, he never learned a trade. A man may be put to look after engine and boilers who knows nothing of the business, but that neither makes him a stationary engineer, nor a skilled workman.

These titles must come through a probationary period of some kind, devoted to learning the business; during this period the word skilled is not applicable.

Mr. S. Bolland, author of the article on moulding propeller wheels, which appears on our first page this week, is a foundryman of large experience both in this country and in England. He has gathered the results of his observation and practice in a tangible form for future use, and readers of the AMERICAN MACHINIST will hear more from him in the future. Mr. Bolland proposes to publish a book on foundry matters some time hereafter. He understands how to present practical matters in a plain, intelligible way.

An Editor Buys a Rolling Mill.

Editor Joseph D. Weeks, of the *American Manufacturer*, Pittsburgh, has bought a rolling mill. It is located at Moundsville, West Va., and was sold at Commissioner's sale. What seems peculiar to us is that he had to buy that mill twice, and now tells his readers that "it will be his if the court confirms the sale." When an editor buys a rolling mill, a sugar refinery or any other kind of big manufactory in this part of the country, he gets it at the first purchase if he has the money to pay for it. Somehow the courts in West Virginia seem to dispute an editor's right to own anything more valuable than a pair of shears and a paste pot. Mr. Weeks, too, has been badly treated in this purchase. After the mill was "knocked down" to him once, they found a man willing to pay ten per cent. more for it, and the commissioners soon discovered a law requiring it to be sold again. Then Mr. Weeks had to see the ten per cent. and go something better to secure its being "knocked down" to him the second time. Latest advices from West Va. show that those intolerably enterprising commissioners are skirmishing around lively to find a man who can be induced to pay a little more for that mill. Meanwhile the court reserves its decision.

Some carping critic may ask: "What does an editor want with a rolling mill?" As an annex to an ordinary newspaper office it would not only be useless but bothersome. But Mr. Weeks edits an iron newspaper and when he can tell readers who are looking for mill improvements "the way we do it up at our mill," he advances his paper at least one peg higher than any other of its kind in the whole country.

The *New York Evening Post* is trying its best to persuade workmen who send money to the officers of trades unions that a large part of the money is stolen by the men designated to receive and distribute it. But the *Post* fails to name a single instance to support its malignant accusation. We have not heard of the treasurer of any trade union skipping for Canada with trust funds in his possession, to join that wealthy colony of bank officers composed of John C. Eno and others, who have stolen millions, and who have been recommended in the highest terms for uprightness and reliability by the *Evening Post*. Workmen who are careful of their money would do well not to trust too much to financiers on the recommendations of the *Post*.

There seems to be a wide divergence of views about the results likely to be accomplished by agitating the much mooted labor questions. One of our New England exchanges publishes items about the refusal of large orders by Maine shipbuilding concerns, by reason of uncertainty in the labor situation; also expressions of other concerns in that line, to the effect that they might as well shut up shop and go out of the business. At the same time, another New England exchange publishes notes about large capitalists who propose to start a new and extensive shipbuilding establishment in the same city where the depression exists, according to the other paper.

The forthcoming tests of freight car brakes by the Master Car Builders' Association bids fair to be the most important of any yet entered into. The brakesman's life on freight trains has hitherto been one of terror, notwithstanding the automatic coupler has been ready to relieve much of this. It is too much to expect of railroad corporations that they will relieve him of much of this unless it can be shown that it will pay, in dollars and cents, to do so.

It is time somebody "Yankeefied" drawing instruments. Watches and small machine tools have received attention, but Swiss and German drawing tools still retain their ugly sharp corners and angles.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(214) "Apprentice," South Easton, Pa., asks for a recipe for making soda water for drill press use. *A.*—In general practice, no strict rule is observed in the proportion of soda and water. Try putting about ¾ lb. of sal or washing soda into a pail of water. If the solution does not prove strong enough, add more soda.

(215) G. W. C., Vincennes, Ind., writes: Can you tell me of a solution which will loosen iron borings which have become attached to the arms of a fly wheel? The wheel was wet with urine at time of packing. *A.*—The iron borings are attached to pulley by a "rust joint." To remove, the wheel should be pickled in the manner usually used for removing scale from castings.

(216) V. C. S., Phœnix, N. Y., writes: Can a water-tight valve-seat be as easily made (ground) between cast and drawn brass as between two cast brass pieces? Can a water-tight valve and seat be ground between two cast brass pieces as easily as between two drawn brass pieces? *A.*—Two cast brass pieces will grind together easier than one drawn and one cast, or than two drawn pieces of brass. There will be no difficulty in grinding either, if care be taken and frequent changes of contact made during the grinding. Use quartz in preference to emery.

(217) C. M. J., Philadelphia, Pa., asks: In an engine of 113″ area of piston, 36″ stroke, cast iron crank shaft 7″ diameter, 6′ long, pulley 3′ from crank, what power in pounds on piston will the shaft safely stand; also what power would be required to break the shaft with crank at right angles to stroke? *A.*—The formula for torsion, as given by Trautwine, is:

$$\left\{\frac{\text{(Cube of dia. in ins.} \times \text{constant)}}{\text{Leverage in feet.}}\right\} = \left\{\text{Breaking force in lbs.}\right\}$$

He gives as a constant for average cast iron 600, hence:

$$\frac{7^3 \times 600}{1.5} = 137200 \text{ lbs.}$$

on piston required to break the shaft. It ought to stand one tenth of this with safety. The weight of the pulley will have an influence to weaken the shaft to resist torsion, but unless it is unusually heavy it need not be considered, particularly when, owing to the uncertainty of the quality of cast iron, a small constant and a large factor of safety are used.

(218) L. E. M., Cortland, N. Y., asks how milling cutters are measured, whether by angle at center, or the angle between face and plane of largest diameter? *A.*—Cutters are usually measured by the angle made by opposite faces if produced until they meet.

(219) J. W. G., ——, Mo., writes: Will you tell me how to calculate the thickness of metal required for the cylinders of hydrostatic presses in order to stand any given pressure. I have a rule which I use, but do not know that it is correct. It is as follows: Multiply the pressure in tons per square inch by half the internal diameter of cylinder, and this product by one of the constants given below, according to the material used for the cylinder the product will be the thickness of metal required for cylinder. The constants are as follows: Cast iron, .41; gun metal, .22; wrought iron, .14; steel, .6. *A.*—The above rule differs slightly from those used by John Robertson & Co., Brooklyn, N. Y., to whom the above query was referred. One rule there in use is: Multiply the pressure by one-half diameter of cylinder, and divide by tenacity of material used. Another: Multiply the pressure per square inch in pounds by diameter of cylinder in inches; divide the product by estimated practical tensile resistance, or value of the metal in pounds per square inch, and the quotient will give thickness of metal required.

(220) E. and A., Wasica, Minn., writes: We have in operation in our mill one boiler which is 54"x14'. We have another boiler, not in use, which is 44"x12'. We propose to put in the smaller one alongside of the one in use, as we are crowded for steam. We wish to know if the two boilers are brought to the proper level at top of flues, and are not connected at bottom through mud drums, with proper connections at steam domes, which on both boilers are 36"x 36", if there will be any trouble about maintaining a steady water level in both boilers due to difference in size of same. *A.*—There should be no trouble in running the boilers, connected as above, provided the chimney is large enough for both boilers. Check valves should be placed in the feed pipe, as near as possible to the boilers, and stop valves must be provided so that the boilers may be fed separately. Attempting to feed two or more boilers at once is poor practice, and should be discouraged, unless special apparatus be made for that purpose.

(221) T.W., Lawrence, Mass., asks: What is a dead-stroke hammer? *A.*—It is one in which there is some elastic connection between the driving mechanism and the hammer. Nearly all hammers in common use are dead-stroke hammers.

(222) E. S., Coosaw, S. C., writes: I have a gear of 12 teeth upon a shaft running 75 revolutions. I wish to gear to a countershaft, and from the other end of countershaft through intermediate gear. I wish to drive a shaft 5 revolutions through a gear of 112 teeth. What gears do I need on countershaft, and for intermediate? *A.*—The number of teeth on intermediate gear will make no difference in speed of shafting, and does not enter the question. Divide 112, the number of teeth in large gear, by 12, the number in small gear; the quotient is 9⅓. Divide 75 by 5, the number of revolutions, and the quotient is 15. Without demonstrating why, it may be stated that the ratio of gears required on countershaft will be as 9⅓ is to 15, as obtained above. Multiplying both numbers by 3, to get rid of fractions, we obtain 28 and 45, the number of teeth in gears to obtain the desired result. Any multiple of these numbers will also answer, as 84 and 135, or 56 and 90.

(223) J. C., Prescott, Ontario, asks: What is the best practice in dropping the bottom of a cupola after the pouring is over; to melt the balance of the charge or dump it immediately? I have followed the latter plan for years, but I have never employed a moulder yet who did not think the former one correct, and I know it is customary to do this. But where is the sense, or what the use of doing so? *A.*—We have referred this question to L. C. Jewett, who answers as follows: To drop bottom, or dump, as soon as sufficient metal is melted, has been my invariable practice, for the following reasons: 1. The fuel in the cupola on level with tuyeres becomes spent soon after the wind goes on. Evidence of this is that it becomes black in tuyeres, and the melted iron dropping upon it congeals, and the tendency to bridge over increases as the time of blast is lengthened. To have a hole through cupola after dropping bottom is desirable without having to make one after bottom is dropped. 2. It decreases the wear and tear of blower, belts, and all that goes to lower expense. 3. It saves the fire brick in cupola, as the last blowing that goes through the last charge, having nothing to absorb the intense heat, the fire brick are consumed more in five minutes than they would be in one hour if there was part of a charge to choke the blast. And there is not as much iron wasted, for if the iron is all melted that has been charged in the door, and after pouring off a surplus remains, quite a quantity is lodged among the spent fuel in the tuyere zone (if I may use the expression), in small globules that are generally lost. A great deal of the last part of charge is carried off in small scintilating sparks, that make such beautiful displays from top of cupola stack when run after dark, and this is quite an amount. 4. There is no more trouble in picking out bottom, if dropped with unmelted stock, than there is to take care of the melted overplus. The cupola should be drained as dry as possible at all times of melted metal before dropping bottom, otherwise there would be danger from the melted metal. Many accidents have occurred from a neglect of this matter.

(224) A. D., Lancaster, Pa., writes: The Hartford Boiler Insurance Co. say that the saw-mill boiler is more likely to explode than any other. What is the reason for this? *A.*—We do not know any reason, unless that, as a rule, they are more recklessly handled, and the material used for firing such as to make sudden rise of pressure probable. 2. Is there any economy in carrying more than steam enough to do the work? Say if 60 pounds pressure will just do the work, will I gain anything by carrying 10 or 15 pounds more? *A.*—It will depend largely upon the kind of engine you use. If an automatic cut-off engine, you would undoubtedly gain in economy by carrying higher pressure If a full-stroke throttling engine, there might or there might not be a gain in higher pressure, depending upon its construction. The best way to find out is by experiment.

(225) W. D., St. Louis, Mo., asks: Can I get steam enough from a tubular boiler with five feet heating surface to run a 2"x3½" stationary engine at 300 revolutions, and what power can I get from such an engine? *A.*—With 70 to 80 pounds pressure you ought to get from ⅓ to ¾ horse-power. Your boiler would only be about one-half large enough to run at full power.

(226) E. C., Samden, Ark,, writes: A Hancock inspirator is used to supply water to a boiler from a well which is near, and does its work easily. There is a well with better water sixty yards distant. Will the inspirator bring it, if a pipe is laid to that well? *A.*—The above question was referred to the Hancock Inspirator Co., who answer as follows: "E. C. can take water from the well sixty yards away if it is not too deep and he is careful to have a tight suction, and have the suction pipe large enough, as the friction of a longer pipe will reduce the amount of water passing through. The pipe should be two sizes larger than the machine connection, and the well should not be much over 20 feet deep on so long a trail.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Patent Att'y, H. W. T. Jenner, Washington, D. C.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

T. M. Parker, Steel Stamps, Stencils, Hartford, Ct.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 48 Beekman st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

"Morrison's Practical Engineer." A complete treatise (200 pp.) on steam and general mach. Mailed on receipt of $1. W. A. Morrison, Box 373, Lowell, Mass

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Curtis Pressure Regulators, Curtis Return Trap Curtis Damper Regulator. See May 1, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-taught," $4. Books for workmen. Joshua Rose, Box 3306. New York City.

Bound Volumes of the AMERICAN MACHINIST for the years 1880, 1881, 1882, 1883, 1884 and 1885. These volumes are strongly bound in cloth, and will wear well. Price $3.50 each; express charges additional. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding, if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G Co., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, post-paid. For sale by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES

The Crown Cotton Mills, Dalton, Ga., will enlarge their factory.

Guest & Clark, Darby, Pa., are building a carriage factory.

J. N. White, of Otter River, Mass., will erect a large machine shop. T. F. Lyon, contractor.

The Raleigh & Gaston Railroad will build a new round-house at Raleigh, N. C.

J. H. Cole, Parkersburg, W. Va., is rebuilding his foundry and machine works.

M. L. Hussey is building a carriage factory at Tarboro, N. C.

The Maine Central Railroad shops are to be located at Waterbury.

P. R. Albert and others, Chattanooga, Tenn., are about to build a car factory.

Charles D. White, Winchendon, Mass., proposes to erect a cotton mill 150x50, three stories.

Extensive repairs will be made to the Delaware rolling mill at Boonton, N. J.

Morris & Selover, builders, will erect a 100x40 foot factory, four stories high, on Atlantic ave., Brooklyn, N. Y. It will cost $22,000.

The Diamond Fire Clay Co., are building works at Denison, Ohio. They will make sewer pipe and terra-cotta.

The Spangler Manufacturing Company, York, Pa., is building a large factory for the manufacture of agricultural implements.

The Dakota Iron & Steel Co., of Minneapolis, capital, $350,000, are to erect iron and steel works at Fargo, Dakota.

Sheldon, Bassett & Co., Birmingham, Conn., have begun the manufacture of steel wire nails. They expect soon to have 50 machines running.

R. Smith has just commenced a foundry at Pontiac, Mich., in the building formerly occupied by S. C. Pillsbury.

Jones & Laughlins, of Pittsburgh, Pa., will make extensive repairs to their iron works. Estimated outlay, $100,000.

Smith, Vaile & Co., Dayton, Ohio, manufacturers of steam pumps, have been incorporated as the Smith & Vaile Co. Capital, $250,000.

The Speers Wadding Co. has been incorporated to manufacture leather belting in Shelby county, Tenn.

B. W. Payne & Sons, engines and boilers, have removed their New York office to 107 Liberty street. H. C. White is manager.

R. M. Brooks will erect at Jenkinsville, Ga., an agricultural implement factory, and a foundry and machine shop. A saw mill is being erected, and a brick yard will be started at the same place.

A $200,000 stock company is being organized at Fort Worth, Texas, to erect a factory for manufacturing carriages, wagons and agricultural implements. It will employ about 200 hands.

There will be no strike for eight hours a day among the jewelers in North Attleboro, as they are only required to work sixteen hours a week.—*Boston Journal of Commerce.*

The firm of Pennigton & Mills, 8 Dey street, Jersey City Heights, N. J., has been dissolved, and Edmund Mills will carry on the business of building light machinery to order.

The Phœnix Iron Works, Minneapolis, Minn., have made arrangements to erect extensive buildings at St. Cloud, and will remove its shops there at an early date.

L. Katzenstein & Co., manufacturers of metallic packing have removed their factory and office from 169 Christopher street, to 357 West street, New York, where they will have increased facilities.

The Eastwood Laundry Machine Co., of Paterson, N. J., formerly Benjamin Eastwood, has been incorporated. Capital stock, $100,000. Benj. Eastwood, Paterson, Chas. Angus, Albany, N. Y., and Uriah T. Tackenthall, Brooklyn, N. Y., corporators.

The Memphis & Birmingham Railroad Company has purchased ground at Birmingham, Ala., for the erection of car shops, freight depots and an elevator. It is said that work on the road will commence within sixty days.

The Lebanon Manufacturing Company, Lebanon, Pa., are about enlarging their works. The old foundry will be converted into a machine shop. A new foundry, 200x60 feet, will be erected, containing all modern improvements.

A company will soon be organized in Waterbury, Conn., with Charles A. Hamilton as president, and W. H. Rogers, of Hartford, as secretary, for the manufacture of silver-plated ware. The plant will be located at Holmes, Booth & Hayden's.

A hotel twelve stories high, with accommodations for 500 guests, is to be erected at Minneapolis at a cost of $750,000. It is the intention to have the dining room on the tenth floor, the kitchen on the eleventh, and the laundry and servants' quarters on the twelfth.

We learn that the addition to the works of the Coe Brass Manufacturing Company, Torrington, Conn., is 169x230 feet. The company are about to put in a large compound condensing engine, tandem type, built by the Watts-Campbell Co., Newark, N. J.

It has been erroneously reported that the Boston & Lowell Railroad would soon build new shops. In answer to an inquiry, J. H. Taylor, superintendent of rolling stock and machinery, writes us: "We do not anticipate building new shops at Lowell. No point has been decided upon, and will not be this season."

Engineering, of London, says the Hotchkiss Mechanical Boiler Cleaner "has made considerable progress within the last few months in this country, and there are several firms in London who have a dozen or more of these instruments at work." The Havemeyer & Elder sugar refinery, of Brooklyn, N. Y., have recently had 100 of these cleaners placed upon their boilers.

The Brown Hoisting and Conveying Machine Co., Cleveland, Ohio, will shortly erect shops equipped with the latest and most improved machinery. Among work now nearing completion are several hoisting machines for France, Belgium, Spain and the British Provinces, and for Boston and Pittsburgh, for coal and iron furnace use.—*American Manufacturer.*

Twenty-six men are now employed at the Crist Engine Works, New York City, in making the compound condensing engine bearing the above name. At present eight 8"x15" engines for the New York *Times*, two engines for the U. S. Fish Commission, one each for the Boston *Globe*, J. M. Barton, and the steam yacht Calumet are on the floor, and the works are to be immediately enlarged.

The Pittsburgh Brass Company, Limited, which purchased the Eagle Cotton Mills, corner Sandusky and Isabella streets, Allegheny, Pa., will manufacture artistic brass goods on an extensive scale. The company, composed of New England people, has abundant capital. The buildings cover a space of two acres, and have been equipped with the best machinery for the company's purposes.—*American Manufacturer.*

George W. Swett & Co., foundrymen of Troy, N. Y., are thinking of leaving that city on account of their troubles with the moulders. Schenectady urges them to come and take the McQueen locomotive works, and they have also had offers of land in Bath and Newark, on the Erie Railroad. But the discouraging part of the business is that troubles with moulders are just as likely to arise at any of the latter places as at Troy.

The Hartford Tool Co., of Hartford, Conn., write us: "We have sold our business to the Pratt & Whitney Co., who will continue the manufacture and sale of these well-known tools under the supervision of the writer, (J. E. Woodbridge), who will be manager of the department in which are made all the taps and dies, and work in this line, also all the tools made by the Hartford Tool Co. It is hardly worth saying that all our tools will continue to be made in the best workmanlike manner, and of the best material."

John Robertson & Co., Brooklyn, N. Y., recently received an order from Stockholm, Sweden, for one of their hydraulic presses for covering electric cable with lead armor. The same firm recently received a sample of cable made in Germany, and were asked if the cable could be made in the United States. The questioner was considerably surprised when he was informed that the very sample in question was made with a press manufactured by Robertson & Co. for a German company.

The Southwark Foundry and Machine Co., of Philadelphia, has just completed the following for a Bessemer steel plant for the Pottstown Iron Co.: Two 10-ton converters, complete with supports, tilting apparatus, water-backs and stacks; a compound duplex pressure pump, 21" high pressure, 36" low pressure, 9½" plunger, 36" stroke; a 16" centrifugal pump, complete; two Bessemer blowing engines, 42" steam, 54" air, 48" stroke; a 15-ton hydraulic ladle crane, complete with hydraulic tipping and turning gear, and four 8-ton ingot cranes.

Mr. W. A. Brown, of Terrell, Texas, has had a number of new motive powers built for him at a local machine shop, and for which, presumably, he has found sale. The invention was patented last December, and consists of a combination of pulleys operated by a suspended weight. The weight is hung over a pulley placed at any distance overhead desired, and is drawn up to the proper working height by turning a wheel at the side of the machine. About thirty seconds are required to wind the machine up, after which it will run from fifteen to thirty minutes. Mr. Brown thinks the power is especially adapted to the running of sewing machines and churns, and also thinks it may be used in connection with grindstones, pumps, etc. —*Age of Steel.*

The Pratt & Whitney Co., Hartford, Conn., have issued a new illustrated catalogue of machinery and tools, consisting of 215 pages, pocket form. It shows a wide variety of machinists' tools, such as lathes, milling machines, planers, drill presses, bolt cutters, gear cutters, shapers, drop hammers, taps, dies, wrenches, chucks, standard gauges, and a large number of special machines. The catalogue gives representations of classes of tools, rather than a list of individual tools. It would require a large pamphlet to give cuts of all the sizes and kinds of machines made at these works. When the works are running full capacity employment is given to 680 men. As stated in the introductory to catalogue: "The reputation of the company's tools for exactness, convenience, elegance and adaptation to the end sought is the result of a well defined and persevering course dictated as well by good policy as by sentiments of fair dealing."

Machinists' Supplies and Iron.

NEW YORK, May 13, 1886.

Tho condition of the supply business and manufacturing continues without noticeable change.

Iron—Transactions in American pig have been dull during the past week, leaving the market slightly in favor of buyers. We quote Standard Lehigh and North River brands, $18 to $18.50 for No. 1 X Foundry; No. 2, $17 to 17.50; Grey Forge, $16 to $16.50.

Scotch Pig—There is no demand except for small lots. We quote Coltness, $20; Glengarnock, $19; Gartsherrie, $19.50; Summerlee, $19.50; Eglinton $17.50; Langloan, $19.50, and Dalmellington, $18.50.

Copper—There is no perceptible increase in the demand, prices being maintained at considerable effort. Small lots of Lake have sold at 11¼c.; other brands at 10c. to 10½c.

Antimony—Hallett's, 8¼c.; Cookson's, 9¼c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Situation as foreman of machine shop; references. Address S., AM. MACHINIST.

Wanted—Position by a young man as draftsman and bookkeeper. A. B., AM. MACHINIST.

Draftsman, 5 yrs. exp. locomotives, mach., tools, hoisting machinery, desires engagement. Address Wilbur, AM. MACHINIST.

Wanted—A competent man to manufacture fulminate of mercury and load cartridge primers. State age, experience, etc., with expectations. Address, box 7, AMERICAN MACHINIST.

First-class mech. engineer and draftsman, pract. and theoret., wants position; great experience here and abroad; fair education; can take charge of drawing room. P. O. Box 391, Taunton, Mass.

Practical machinist and engineer, with good references as to character and ability, desires to correspond with South American and European parties in need of his services. Address "Foreign," AM. MACHINIST.

Situation wanted by a competent draftsman; have designed and built rivet-making machinery of the latest improvements, machinist's and special tools; over four years in last situation; good references. Address W. K. Millholland, Cuyahogoa Falls, Ohio.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Compound; ever reliable, never failing. Crescent Mfg. Co., Cleveland, Ohio.

Wanted—Second-hand iron planer; price; size. Browerville Iron Works, Hartford, Minn.

Send for estimates of high-speed compound engines for stationary and marine service. Crist Engine Works, 140 Baxter street, N. Y.

Useful information steam users and engineers 100 page book on care, etc., of boilers. Send 25 cents in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

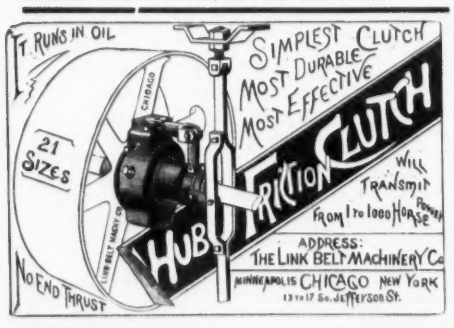
Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

Boiler shop needed in a manufacturing town in New York State; excellent opportunity for a live man; advertiser willing to aid in securing orders. Address Box 8, AM. MACHINIST.

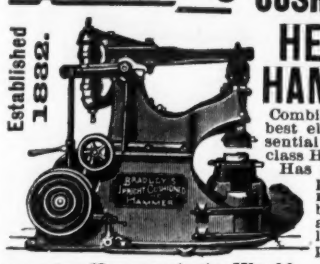
For Sale—12"x18" plain slide valve engine, "Tangye" bed, new; 6 H. P. plain slide engine, *old*; smoke-stack iron, 24"x50', new; 20" Risdon turbine, good order. P. M. Sharples, West Chester, Pa

M. Martin, manufacturer, P. O. Box 285, New Brunswick, N. J., will contract for the manufacture of articles in brass and other metals (stamped or turned), and dies and tools for making same; also patent novelties, electrical inventions, special machinery castings, etc.; estimates cheerfully given.

Wanted—Pattern maker and draftsman, with $2,000 or $3,000, to take an interest in an established engine, saw-mill and boiler works, to work under salary; the entire plant is new equipped with the best tools; has been in operation 2 years; books will show a dividend of 25 per cent.; located in a fine Southern town of 10,000 inhabitants; has the best of prospects for future business; machine shop, foundry and boiler shop operated by practical men, who are stockholders, and all workers; references required and given. For further particulars, address South, care AM. MACHINIST.

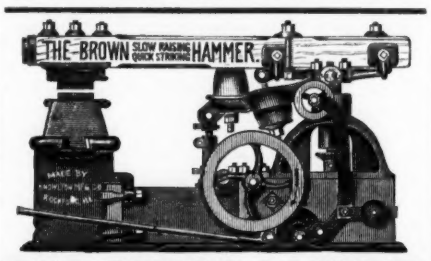


BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER

STRIKES A BLOW WITH DOUBLE THE VELOCITY That it Raises The Hammer.

A NEW MOVEMENT! SEND FOR DESCRIPTION.

KNOWLTON MFG. CO., King St., Rockford, Ill.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER.

By far the Best. Blow Accurate. Powerful and Elastic

Will Increase the Profits of any Shop.

BEAUDRY & CUNNINGHAM, BOSTON, MASSACHUSETTS.

INDICATOR PRACTICE AND Steam Engine Economy

By F. F. HEMENWAY.

CONTAINS plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Table of Contents mailed on application.

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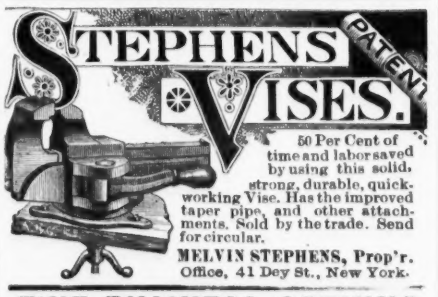

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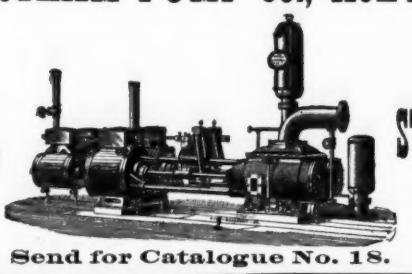

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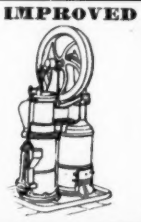

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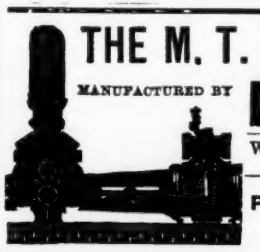

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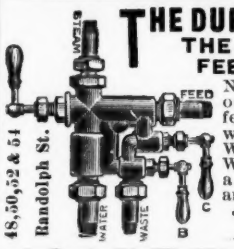

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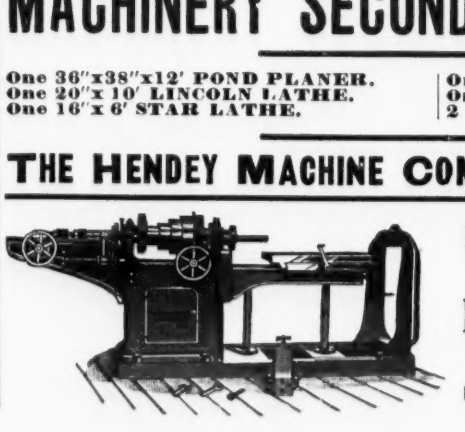

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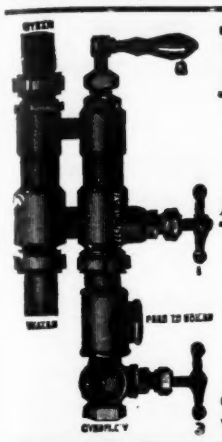

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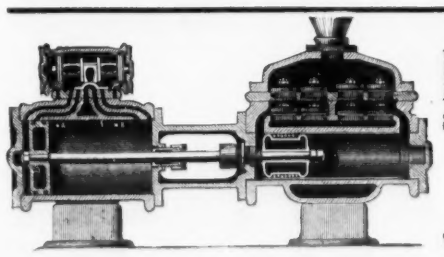

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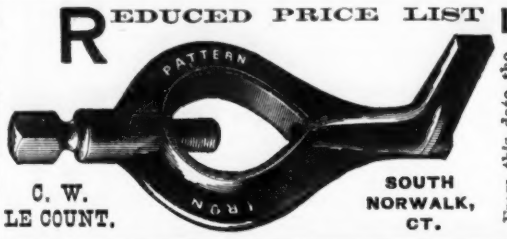

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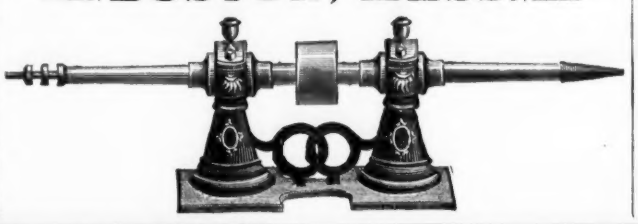

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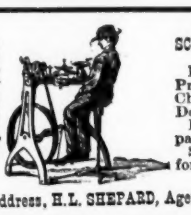

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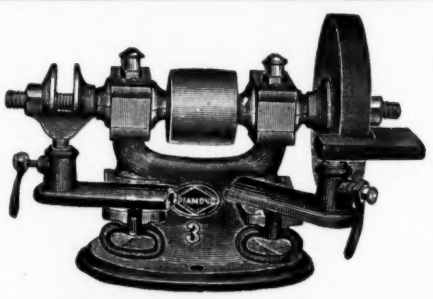

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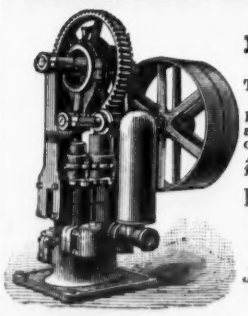

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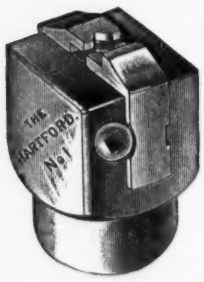

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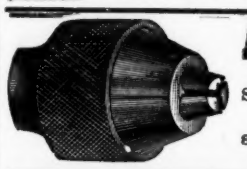

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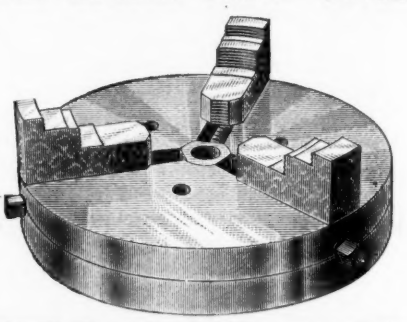

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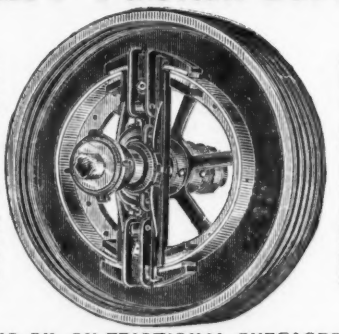

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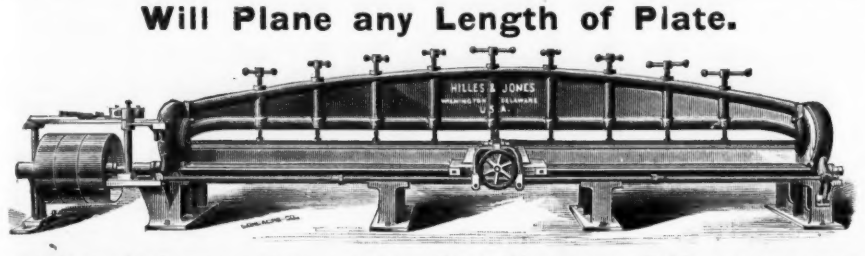

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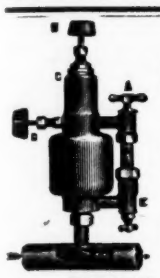

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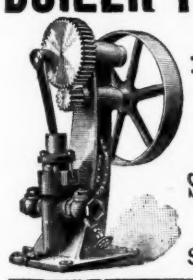

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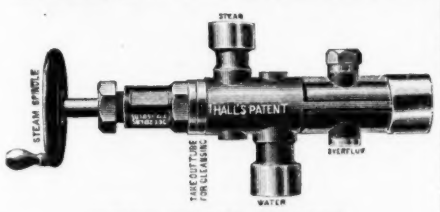

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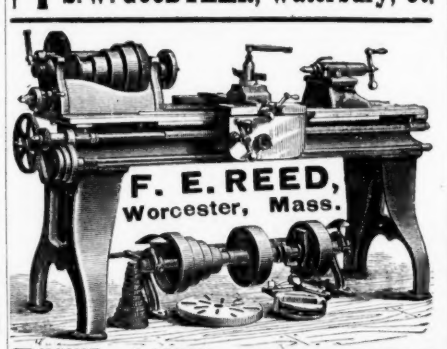

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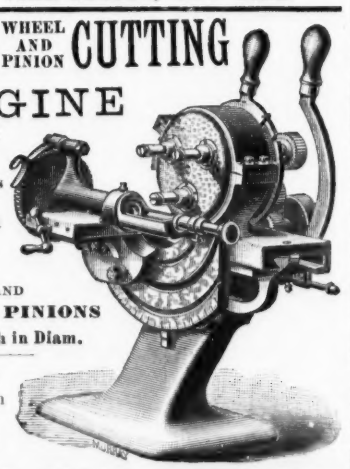

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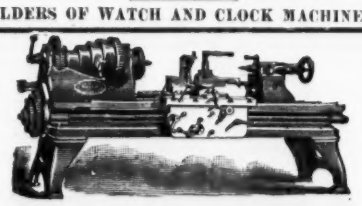

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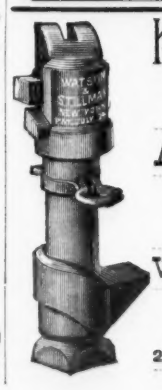

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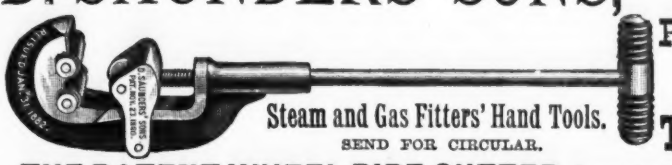

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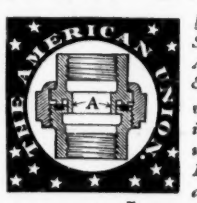

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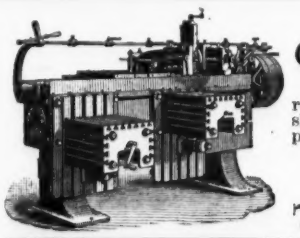

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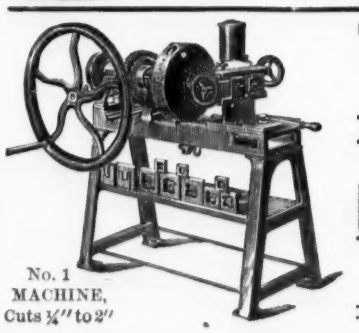

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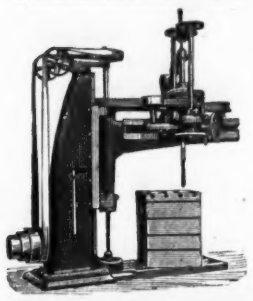

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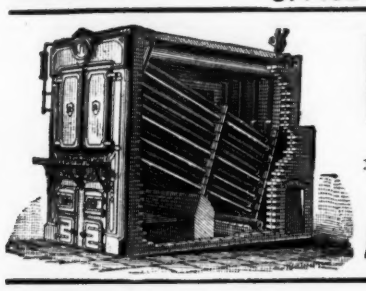

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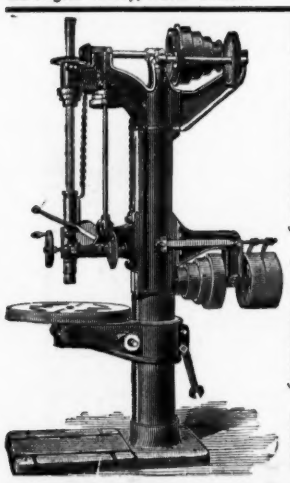

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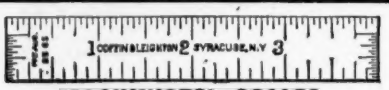

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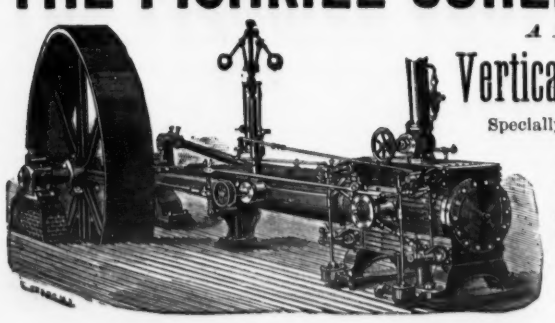

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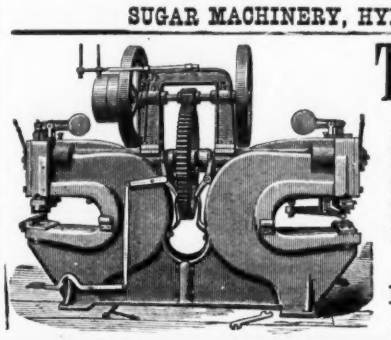

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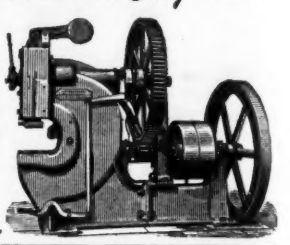

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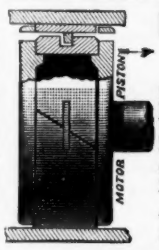

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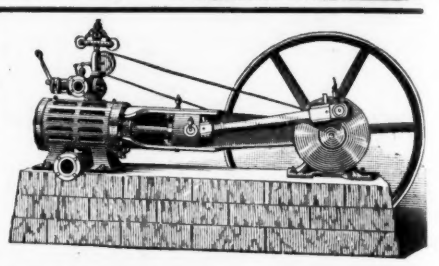

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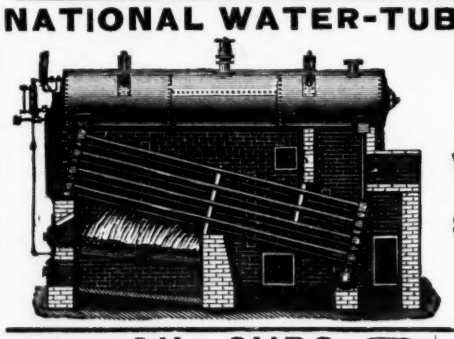

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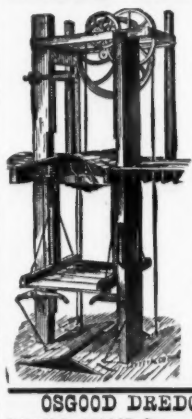

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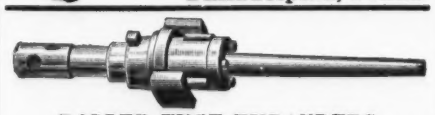

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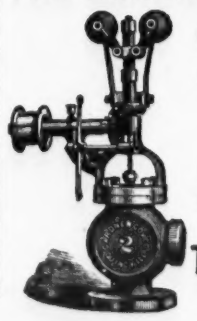

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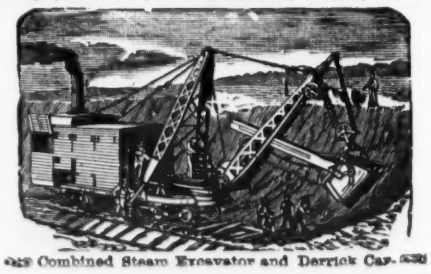

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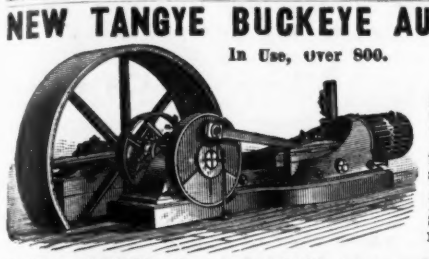

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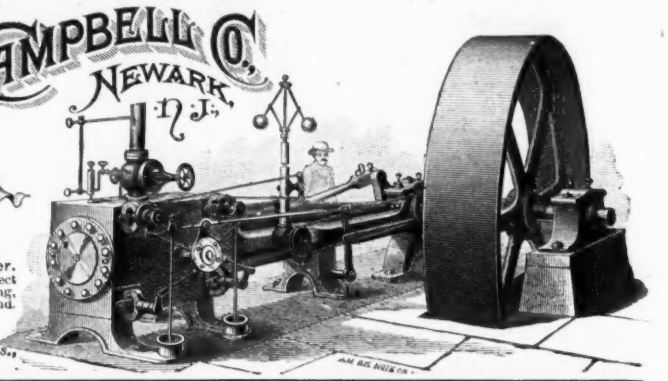

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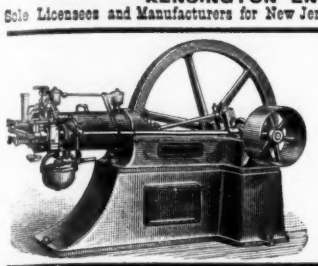

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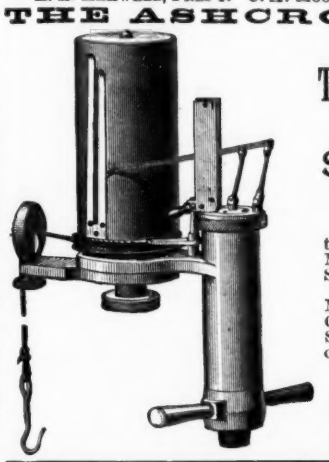

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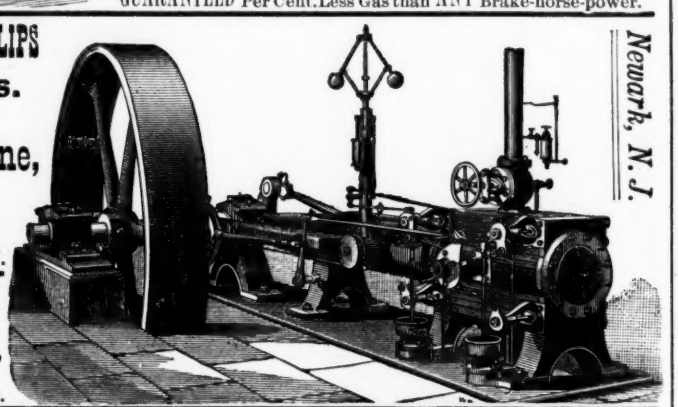

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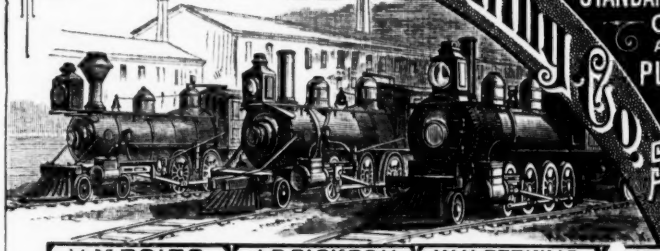

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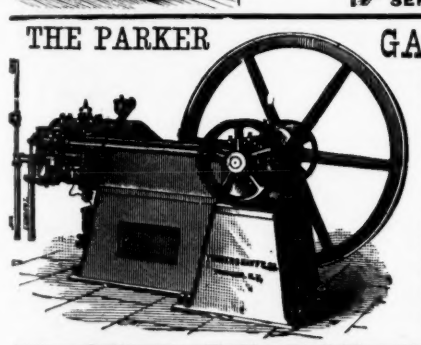

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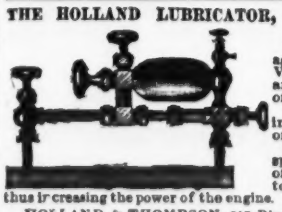

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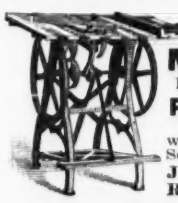

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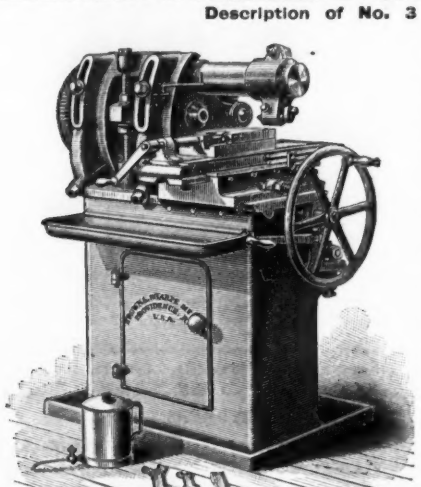

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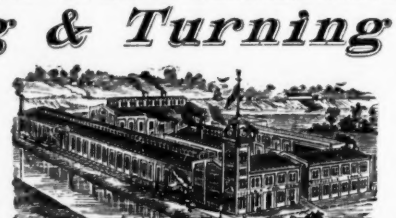

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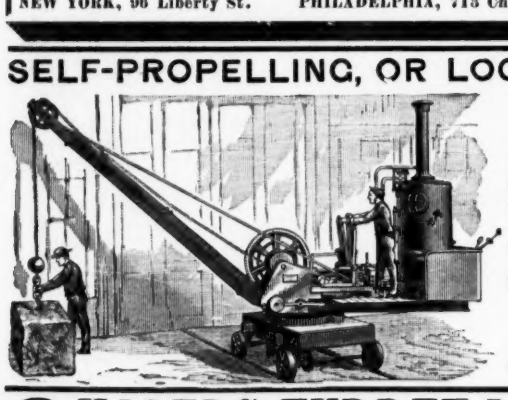

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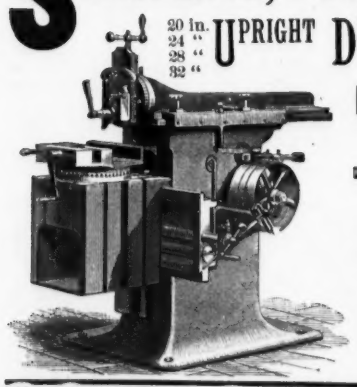

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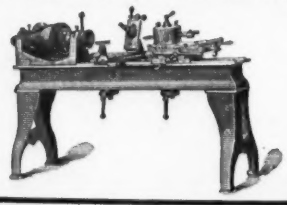

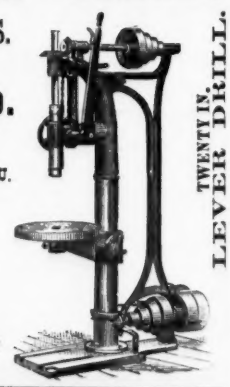

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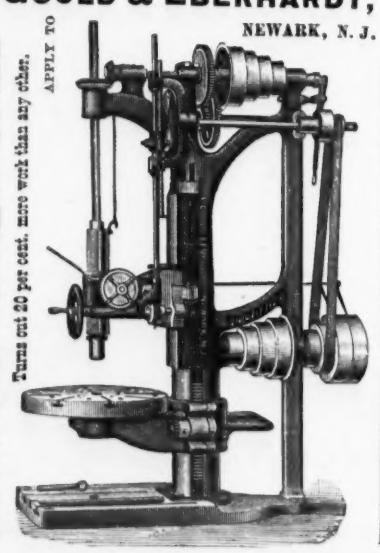

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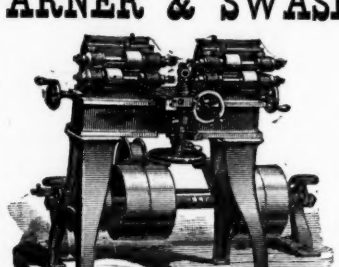

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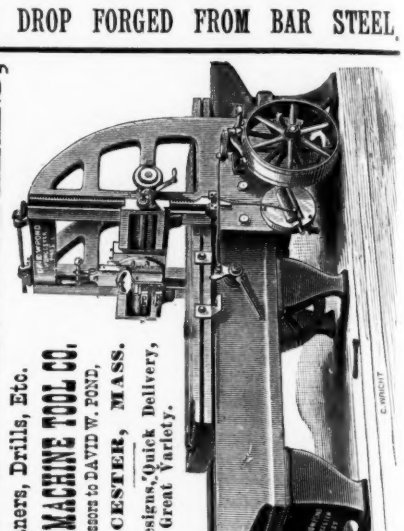

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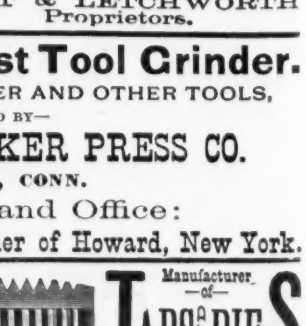

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